COLLEGE OF ENGINEERING CORNELL UNIVERSITY

the Cornell engineer

DECEMBER, 1953

VOL. 19, NO. 3

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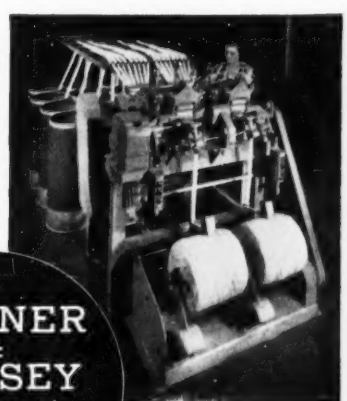
Since time began, the hope of private profit is what has stimulated the drive for efficiency and low costs, out of which everyone benefits. If that is business selfishness, the world needs more of it.



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Your pipe dreams of success in industry are more likely to flow with realities if you associate with a dynamic company. Some companies merely produce a material. Wouldn't you be better off with a company that not only produces a basic material, but also knows how to design and fabricate its own product? *That* company really knows what it is making—and selling. Such a company is Republic Steel.

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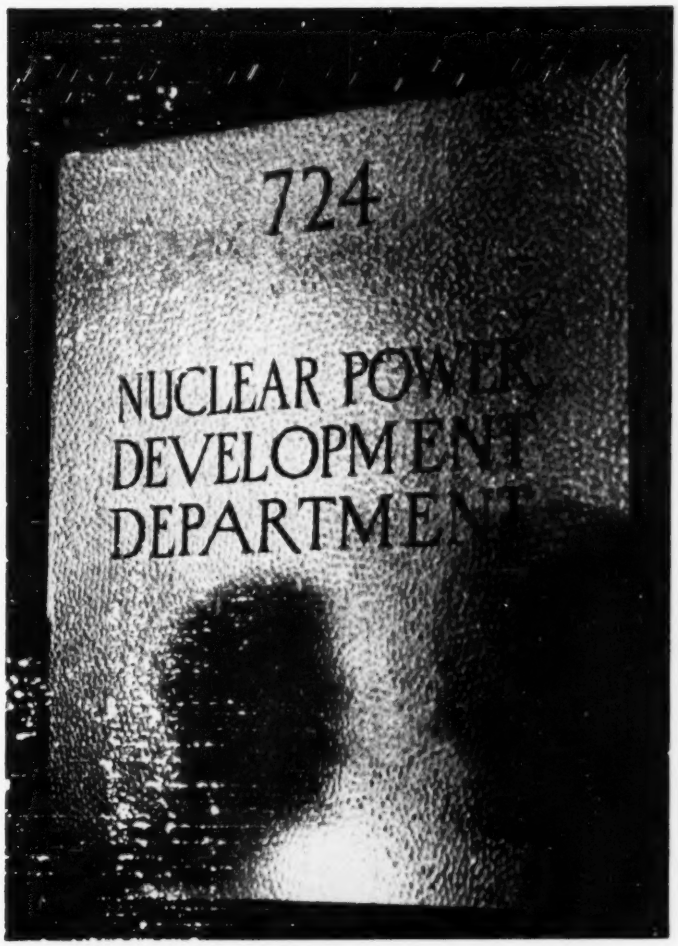

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One of the problems in designing an electronic digital computer for airborne automatic controls is that of storing information used by the system.

Techniques employed in the magnetic drum memory unit of the Hughes airborne digital computer are reviewed by project members Arthur Zukin (left) of the Radar Laboratory, and Dan L. Curtis of the Advanced Electronics Laboratory.

At Hughes, where the airborne electronic digital computer was pioneered, the problem presented by the memory unit was attacked basically by the Hughes technique of systems planning and analysis. This involved an exhaustive examination of the requirements, an evaluation of the best means for satisfying them, and the design of the simplest possible mechanization consistent with superior performance.

A magnetic drum memory unit was chosen as the most compact and rugged storage device for the airborne digital computer. The unit developed by Hughes provides storage space for more than 2500 19-digit words. Density of the magnetic recording is approximately 100 binary digits per inch. Rotating at 8000 rev/min, the 4-inch diameter drum permits computation at a rate of 160,000 binary digits per second.

From an analysis of the logical integration of the memory unit into the computer system, the unique "floating reference" principle was developed. Instead of standard coincidence-type methods for selecting numbers from the magnetic drum storage, a floating reference system is used in which the memory position is determined by counting word times from the *end* of the preceding operation. This technique produces for this application a performance equivalent to a random access memory and results in a substantial saving in equipment.

A major effort at Hughes is also devoted to adapting electronic digital computer techniques to business data processing and related applications – uses unquestionably destined for far-reaching peacetime application.

Activities at Hughes in the computer field are creating some new positions in the Laboratories. Experience in the design and application of electronic digital computers is desirable but not essential. Engineers and physicists with backgrounds of component development or system engineering are invited to apply.

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Comment:

Unions In Engineering

The question of the value of collective bargaining for engineers has been debated among engineers, engineering societies, and unions ever since 1930, when engineers began a gradual shift in status from independent consultant to employee. Engineers have also observed how economic cycles have given union laborers steady wage increases which have easily passed the non-contract salary increases for technical men. The trend towards the unionization of technical personnel has been pronounced, although, thus far, relatively few have joined unions.

There are three types of unions which include professional engineers: those affiliated with the AFL and CIO, those completely independent, and those organized with assistance from the professional societies. Those engineers associated with labor unions have been in the minority among the union members and have consequently had their engineering code of ethics placed aside from the majority. An engineer cannot be considered labor and among a labor group is out of place. Associated with labor, the engineer loses his professional status and the opportunity for promotion into the management class. Therefore, a labor union may help the unhappy, unqualified, or non-aggressive engineer, but is unnecessary and a hindrance to the professional man with drive and initiative.

Independent unions have been organized with the goal of higher pay, better conditions, and a greater share of patent income for the employee. In an independent union, the engineer does not lose professional status, since engineers are in the majority, but he does lose prestige. Today, however, with the scarcity of qualified engineers, the individual has enough power and prestige to bargain singly to attain his particular needs. Also, management would prefer to bargain individually with a professional.

The unions sponsored by the engineering socities have formed primarily for protection against labor unions rather than as collective bargaining units. The engineering societies faced the problem of unionization calmly. Assuming that the situation is satisfactory for engineers today, the societies have decided that there should be no change now. If the situation should change, the societies should strengthen to aid the engineer in maintaining his professional status and in bargaining for his rights. The societies today could institute an employment or placement service for the dissatisfied worker. Labor unions would then be completely unnecessary.

The whole concept of unionization of engineers is contradictory to the engineer's professional code of ethics. His individual initiative would be repressed by the stress on union backing instead of individual merit. The young man with fresh ideas would have to buck seniority rules that would force him to slow his ideas down to the pace set by the more conservative older men.

At this time unions are completely unnecessary for engineers. If the position of the engineer should change sufficiently to warant organization, stronger engineering societies would be the logical solution as collective bargaining agent for the professionals. L.O.

Academic Freedom and the Cornell Community

The question of academic freedom may seem unimportant to some of our readers, and a discussion of this issue may seem unsuitable for a technical publication. However, engineers and scientists can no longer sit back and allow the students of government and politics to argue the question of political freedoms. Cornell University's tradition of freedom and responsibility and the Engineering College's purpose of training good citizens, not just good engineers, should be reason enough for consideration of this problem on these pages.

As this is written, the members of one of the engineering school honoraries are hearing Professor Harrop Freeman of the Cornell Law School present his views on the future of the world. Perhaps some of these engineers, and certainly many of the Cornell community, have heard Professor Freeman and other faculty members speak as participants in panel discussions on complex problems confronting the peoples of this and other countries. For those students who have not taken advantage of opportunities to hear discussed questions of political freedoms and for those alumni who have not been aware of the concern over these matters among members of the Cornell community, we should like to review the con-

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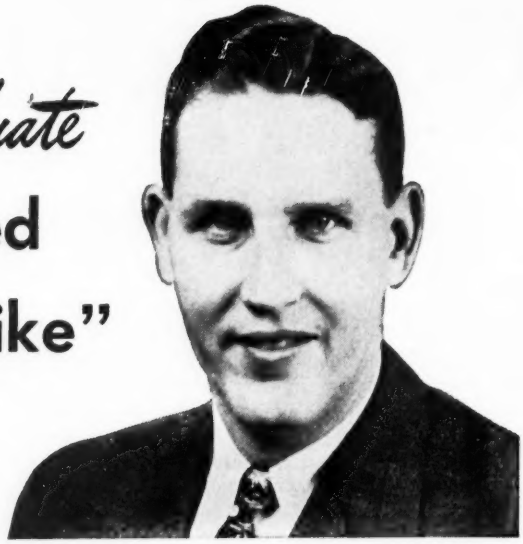

says HUGH C. SELLS,
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"I guess I was like many graduating engineers. I didn't really know what I wanted to do. When the Allis-Chalmers representative visited the campus, and described their Graduate Training Course, it sounded like the type of postgraduate training I really needed.

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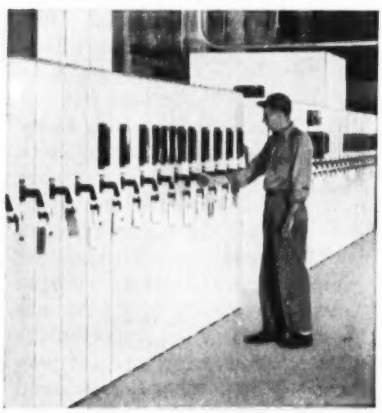

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5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

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tributions of outstanding faculty members, of guest lecturers, and of students.

No doubt most of our readers are familiar with the events which stimulated much of the campus discussion—the threatened investigation of our universities and the subsequent interviewing of two Cornell professors. *The Cornell Daily Sun* performed an excellent job in reporting the latter and in printing articles by men such as Robert E. Cushman, professor of government and expert on constitutional law. As the problem of maintaining academic freedom in the face of mounting fear and hysteria became a serious one in every part of the country, students recognized the need for fair consideration of accused professors and through the National Student Association established an intercollegiate committee to determine and to publish facts regarding any instance of possible infringement of academic freedom. Cornell students became the core of this group when it was decided to establish the headquarters of the committee on this campus.

During Senior Week this past spring, a panel was presented for the benefit of alumni (and attended by many students and faculty) which attempted to explain the concern of the Cornell faculty over methods of investigation of supposed subversive elements in institutions. Moderated by Professor Cushman of the government department and composed of representatives of the Schools of Law, Business, Industrial and Labor Relations, and Agriculture, the panel explained the thorough consideration given by Cornell faculty to the problem of providing fair means of judging any faculty member—the reaffirming in 1951 of faculty responsibilities to our country and to our University. Emphasized by the faculty members was their feeling that no citizen should hide behind the fifth amendment in a denial of congressional authority, but that publicity-seeking methods would better be supplanted by grand jury techniques.

In June of this year, President Malott wrote for the *New York Herald Tribune* an article entitled, "Is Professor 'X' a Red?" In response to blind criticism by alumni demanding that their universities do something about "Professor X," Mr. Malott asked, "Should those who in this unstable day voice dissent be classed as enemies of society? Are all who depart from the ranks of the so-called conservatives to be muffled or fired? If so, by whom, and judged by what standards?" He stated that "thinking citizens must stand behind the principles of freedom of thought and of expression. Implicit is the freedom to make mistakes, to search through error for truth, to express postulates which have not common acceptance."

This article appeared in an early issue of the *Sun* this fall, and subsequently, we have had presented material prepared by Professor Harrop Freeman, of the Law School; a discussion of "witch-hunting" by Chandler Morse, of the Department of Economics; a reprint of a speech given by Professor Cushman for the BBC; and reports of lectures given recently by a visiting professor on "The Necessity of Freedom."

Professor Freeman pointed to the three responsibilities which the faculty must maintain: the national tradition of free political discussion, the "Universitas" concept of free student-faculty inquiry, and the reputation of the University in the eyes of the world.

He dealt with the basis of our democratic society and Cornell's contribution to that society; he discussed the meaning and purpose of academic freedom and analyzed Congressional investigations with their past and probable impact on the Cornell campus.

Professor Morse considered the problem of anti-intellectualism, the condemning of the "internationalist and intellectualist." Professor Cushman's talk over the BBC during the summer pointed out that "we are paying a very heavy price in terms of tolerance and respect for human rights, for having allowed our national and state campaigns against communism and subversion to fall largely into the hands of our politicians." He acknowledged that congressional committees had brought some criminal activity to light, but deplored the difficulty of maximum publicity. Further Cushman stated that a peculiarly dangerous doctrine has developed in recent years which

The "eight o'clock"

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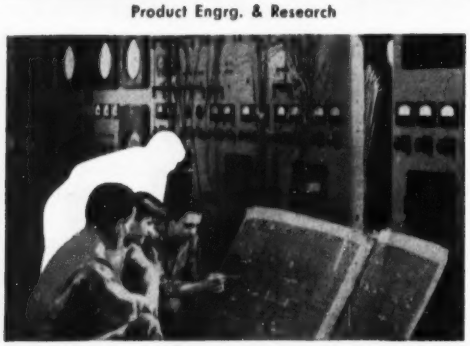
Market Development

Product Engrg. & Research



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holds it disloyal to criticize any of the agencies of government which are combatting communism and subversion—"the doctrine of guilt by association."

Finally, under the sponsorship of Telluride Association (the educational trust which operates the Cornell Telluride House), Henry Steele Commager, professor of history at Columbia University and noted author and lecturer, spoke to members of the Cornell community. He pointed out that Americans have always been "ingenious, practical, and experimental," and that it was only through the encouragement of religious, political, and geographical diversity that Americans have achieved their national and cultural unity. He discussed conformity and nonconformity, the problem of guilt by association, and the necessity of experimentation.

One of the clearest and most logical treatments of the guilt by association doctrine, in essence a review of his second Cornell lecture, was a recent article by Professor Commager in the magazine section of the *New York Sunday Times*. If any of our older readers fear that Cornell and other universities are "warping the minds of their children" or if they have had the frustating experience of trying to reason with strong-minded critics blinded by a national hysteria(as have many of the younger generation), we ask that they review this brief summary of Professor Commager's arguments.

After pointing out that the "crime of guilt by association" made its first appearance in federal law in the Alien Registration Act of 1940 and later in President Truman's Loyalty Order of 1947, Prof. Commager declares that the doctrine is pernicious in principle, in application, and in consequences. He develops these ideas:

1. The doctrine is unsound in logic; it is illogical to hold that a good cause becomes bad if supported by bad men.

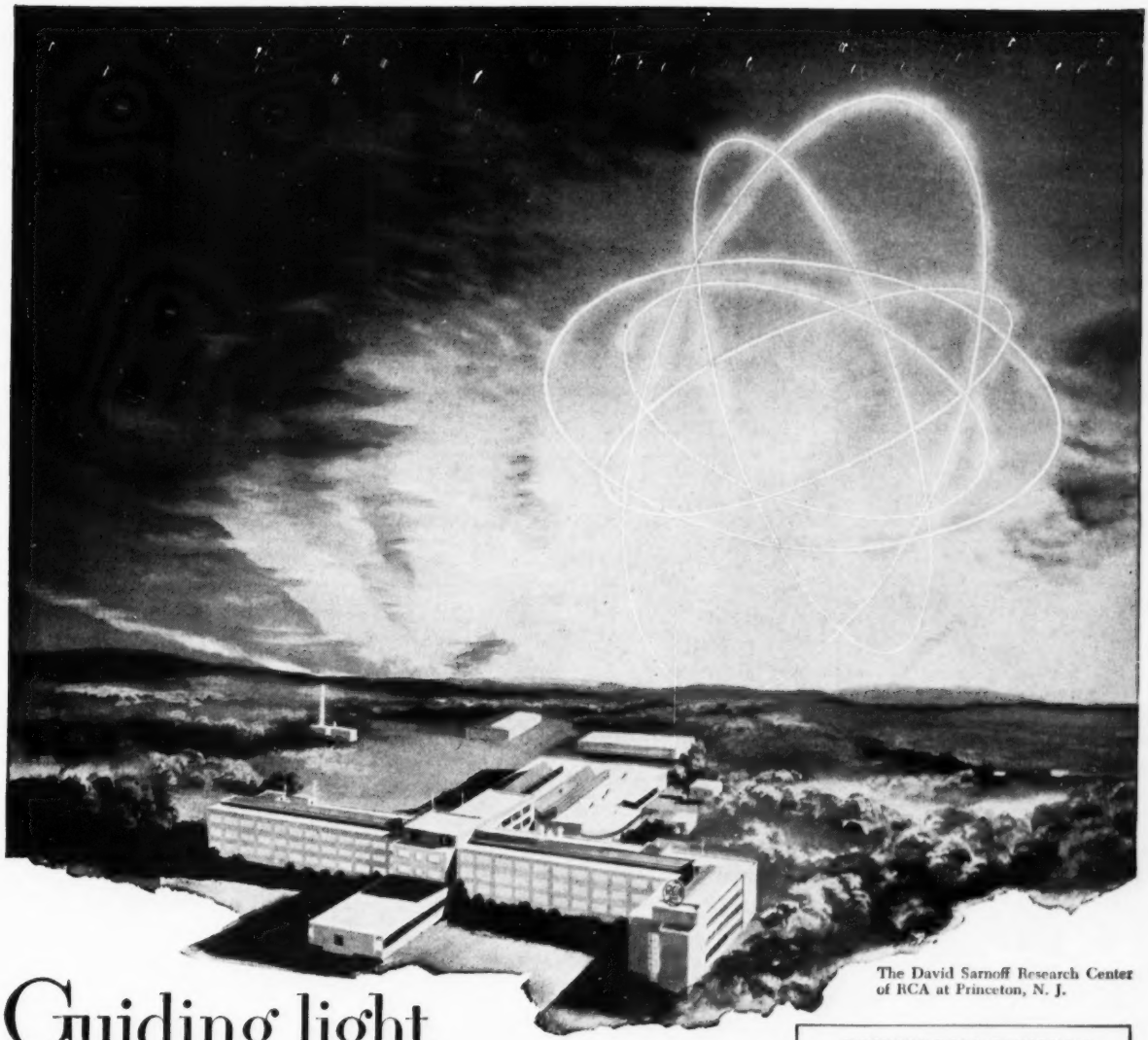
2. It is wrong legally; guilt cannot be collective rather than personal and "ex post facto law" is impossible.

3. It is wrong practically; it is neither possible nor desirable that we engage in a check of the membership, past as well as present, of all organizations to which we belong or which we are asked to join. There is a gap between membership and responsibility in most organizations, and why should liberals be considered to have any different sort of group?

4. It is wrong historically; America is a nation of joiners.

5. It is wrong morally; the doctrine rests on a low view of human nature in assuming greater power in evil than in virtue.

He concludes that witch-hunters are men consumed with fear and hatred, men of little faith, and states that if these men were not hypocrites they would be willing "to submit their beliefs to the competition of the market-place of ideas." "The doctrine of guilt by association is not a convenient device for detecting subversion, but a device for destroying our constitutional guarantees, for corrupting our faith in ourselves and in our fellow men." J.B.



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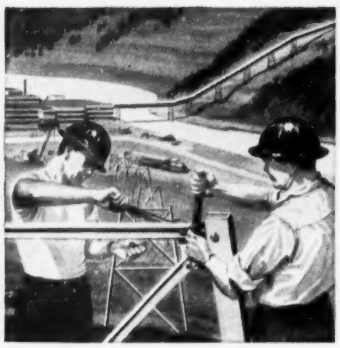

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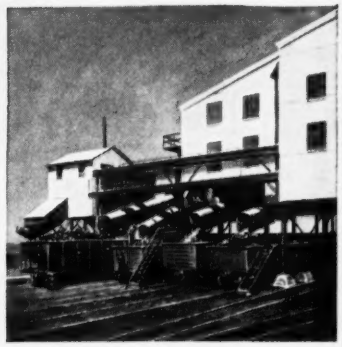

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Founded 1885

THE CORNELL engineer

DECEMBER, 1953 VOLUME 19 NUMBER 3

COVER—View of a portion of Cornell's new men's dormitories which are being constructed below the present dormitory group. See frontispiece for another picture of this construction.

—*Alan F. Cohen*

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Artillery of the Ancients

by ROBERT H. KANTOR, EP '57

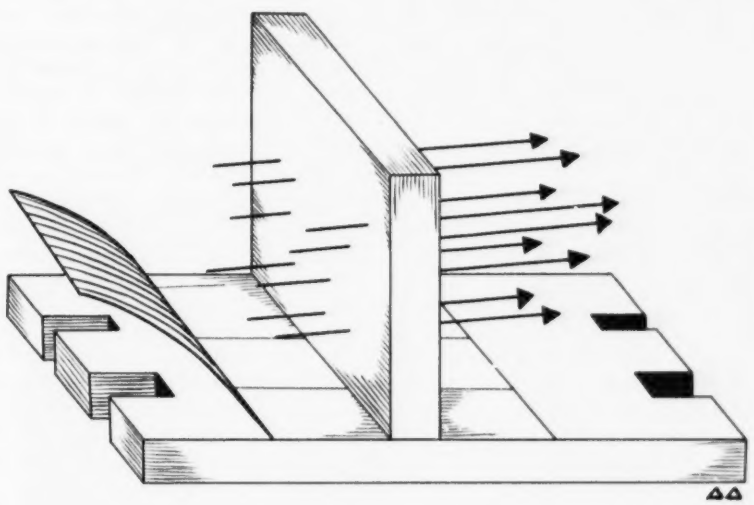
The earliest form of artillery no doubt consisted of a caveman's arm and a rock. From this crude beginning, man progressed to the spear and then to the bow and arrow. These weapons had the obvious advantage that they could bring an enemy down at relatively long distances, thus lessening the importance of sheer strength in both hunting and physical combat. By the dawn of recorded history, man had begun developing more ambitious forms of artillery. The Assyrians were the earliest leaders, followed by the Greeks, and then the Romans. The artillery these ancient peoples devised was, with some modifications, employed in warfare throughout the Middle Ages, and would still be used today if it were not for the invention of gunpowder. These weapons are of interest to us today in that the basic principles of mechanics involved in their construction are embodied in the most complex of present-day howitzers, mortars, and cannon.

There were two distinct forms of throwing machines—the crossbow and the beam arm. Of the two, the former was invented earlier and will be discussed first.

The Ballista

The oldest form of the crossbow-type weapon, the ballista, consisted of an upright, rectangular frame with two inner, vertical supports which divided the frame into three parts. A trough, or grooved slide attached at right angles to the bottom of the frame in the middle opening gave the machine somewhat of a T-shape. The bow arms were embedded in twisted rope or mule gut wound vertically through holes in the top and bottom timbers of the two outer openings in the frame. Cords from the bow arms were attached to the carriage or arrow block in the trough. The tension in the wound rope on the bow arms was such that a windlass or lever-cocking device was required to draw the bowstring back. The entire framework or head was mounted movably on a base so that the angle of the trough could be altered for variations in range. The ballista was capable of hurling rocks weighing sixty pounds a distance of 400 yards, and some possessed maximum ranges of 800 yards. However, rocks were not the only missile the ballista could hurl; it fired arrows and darts as well. During sieges, the attackers, using ballistas, often hurled putrid animal carcasses into the besieged castle or town in an attempt to spread a plague. Toward the close of the Middle Ages, refined types, which were mounted on wheels and were capable of quick maneuvers, were devised. These were in many respects analogous to our modern, light field artillery units. The carroballista is a good example of this type. Horses and mules were harnessed onto the mounts so that the darts or javelins were shot between them. Some ballistas could be carried and operated by one man, but when these machines became so light and portable, they fell under the classification of catapultas.

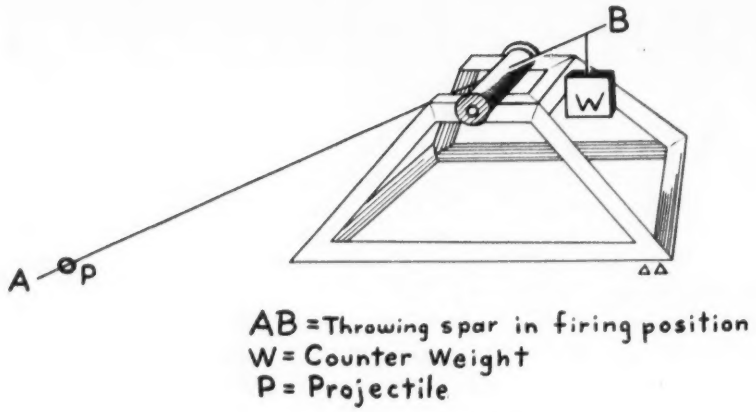
Catapultas were essentially small ballistas although a distinction is usually drawn regarding the method



Beam-arm weapon known as the trebuchet

Pouring concrete for new men's dormitories at Cornell.

—*Alan F. Cohen*



Beam-arm weapon known as the trebuchet

of propulsion. Whereas the ballista operated like a bow, a cord being pulled back and then released, catapultas depended upon twisted cords for the elasticity for their projectile force. Another distinction is made with reference to the missile fired, for while the ballista could shoot rocks, arrows, javelins, and dead animals, the catapulta could fire only arrows. Still, the catapulta was an extremely potent weapon. Several elaborate forms were devised. One discharged whole flights of darts simultaneously (thus becoming the earliest forerunner of the machine gun). Others had a metal bow, fully eighteen feet long, that was capable of shooting an arrow three times further than the strongest archer.

Beam-Arm Weapons

The beam-arm weapons respresented a great advancement over the ballista and catapulta with respect to destructive force. The Romans developed the first of these —the onager. This machine had a flat, rectangular frame and a long arm that was pivoted in a roller. The arm was almost flat against the frame when drawn down. Upon discharge, the beam arm came to rest in a nearly vertical position against a support built up from the framework. The motive power was supplied by either a built-in wood spring exerting pressure on the arm from behind, or by the tension of a skein of twisted rope on which the beam was bedded. A spoon-shaped enlargement at the beam top held the missile, while a windlass, fitted to the frame, cranked down the arm, which was released by a trip trigger. This machine could hurl fifty to sixty pound stones from 400 to 500 yards.

A simplified variation of the onager was the springald. The springald carried a light dart held in place by a fixed support. Mounted behind the dart in place, the spring, when pulled back and released, would project the dart a considerable distance by striking its base with a sharp blow.

Toward the end of the Middle Ages, onager-type weapons underwent great improvements. The most significant change was the substitution of a counter-balance weight for springs or torsion as the motive power for the beam-arm. This new machine resembled an "old oaken bucket" type of well sweep with its long beam mounted upon an axle running between fairly high supports. The axle divided the beam unequally, the shorter part of the arm pointing upward, and the longer part resting on the ground. A sling with a pouch suitable for the size of the missile to be used, was attached to the longer arm, while at the other end, the sling cord was attached to a rock weighing from one to ten tons. The long arm of the beam was then drawn down by a windlass, held there, and the missile was placed in the pouch. To fire the missile the cord of the windlass was released, and the counterweight would cause the entire beam to swing up and out, hurling the projectile a good 300 to 400 yards. This weapon was known as the trebuchet and is represented above diagramatically.

The trebuchet had to be carted around on a wheeled carriage since the massive counterweights were stored in a receptacle in the underbody. Choice of the proper counterweight depended upon the range desired and the weight of the missile used; these missiles often exceeded 300 pounds. The trebuchet could never be used at less than 200 yards from a besieged fortress, since at this range, the arrows of the enemy archers were still dangerous. Nevertheless, the trebuchet was the most powerful and effective of the pre-gunpowder artillery. In fact, many years after the first cannon appeared on European battlefields, this last of the beam-arm weapons still remained the mightiest of hurling machines.

Naval Artillery

All the devices thus far described have been instruments employed solely for land warfare. Because of their bulkiness and short range, they found only occasional use in naval engagements. Instead, the warships of the time used what was known as Greek fire. Greek fire was the predecessor of the present-day incendiary bomb. It was an agglomeration of sulfur, lime, tar or pitch, naphtha and saltpeter. To these ingredients were added burning aids, such as charcoal, sawdust from resinous woods, and bitumen. Once ignited, this mixture was practically impossible to put out. In a sea battle, the Greek fire was usually ejected from huge siphons placed in the bows of galleys, and on contact with water, it flared up spontaneously. More explosive varieties of Greek fire were ignited at the breach end of tubes, similar to later cannons, and allowed to blow themselves out on an enemy in a fiery spray.

The ballista, the trebuchet, the catapulta, and Greek fire, though puny when compared to the weapons of the twentieth century, no doubt struck as much terror into the hearts of medieval men as their modern counterparts do to present-day populaces. Considering the limited facilities and crude tools he had at his disposal, the military engineer of ancient times and of the Middle Ages was able to construct war machines whose power and maneuverability are a tribute to man's mechanical genius.

THE ENGINEER COMMEMORATES

Fifty Years of Flight

by JANICE BUTTON, EP '54

and RICHARD BRANDENBUBG, EP '58

Fifty years ago this month, on the wind-swept slope of Kill Devil Hill at Kitty Hawk, North Carolina, a man-carrying flying machine struggled into the air to mark the beginning of modern aviation. December 17, 1903, was the date of that first flight, which lasted 12 seconds and covered 120 feet with a maximum speed of 31 miles per hour. Orville and Wilbur Wright, through persistent experimentation and home study, had succeeded in the first step towards man's conquest of the air with a brief flight that was to affect the lives of men everywhere.

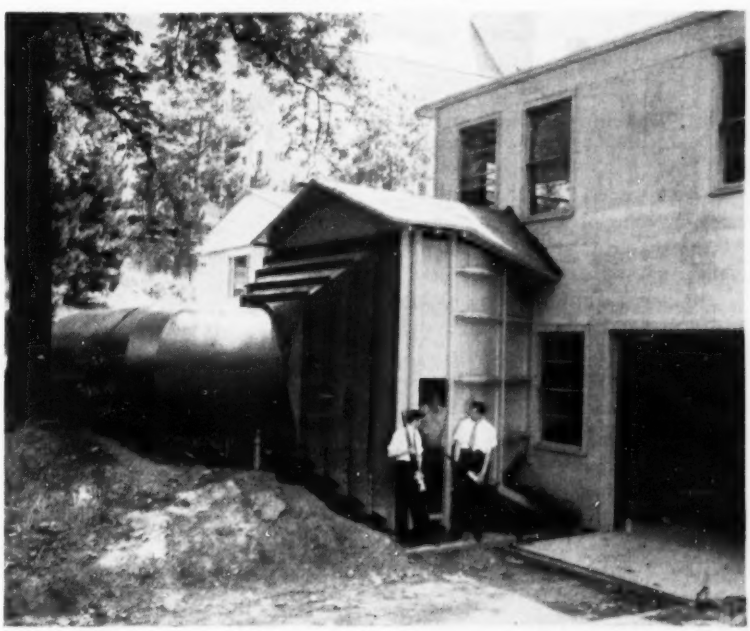
The first powered flight was not the result of luck and guess-work on the part of two bicycle repairmen. The Wright brothers began working with gliders in 1900. The poor performance of their machines, designed on the basis of Otto Lilienthal's allegedly reliable air pressure tables, led the Wrights to correspond with glider-experimenter Octave Chanute in an effort to obtain practical airfoil data. In 1901 and 1902, the Wright brothers built their own wind-tunnel, the first of its kind in the world, for testing their own wing designs. They also flew over 1000 feet with a glider that used a successful system of rudder, elevator, and aileron controls. In preparation for their historic flight in 1903, the Wrights designed and built their own 12 horsepower engine and calculated for the first time a formula for ideal size and pitch of propellers.

The Wright brothers' imaginative research, continued by aviation pioneers over a short period of fifty years, has sparked the development of the airplane from the crude wood and wire device that flew at Kitty Hawk to the modern jet-propelled engineering miracle known as the B-52. In fifty short years, the American aviation industry has created a multi-million dollar aircraft that flies at five-hundred fifty miles per hour and is driven by eight jet engines delivering 80,000 horsepower.

Aeronautical research has pushed rocket-powered planes through the sonic barrier to speeds of 1,328 miles per hour and altitudes of better than fourteen miles. This country will produce more than 17,600 planes this year, 4,700 of which will be used for public air transportation. Constantly expanding, the American aviation industry in 1952 possessed 2.4 billion dollars in capital and spent over 208 million dollars for new plants and equipment. More than 750,000 citizens are now earning their living in the airplane manufacturing industry, while an additional 100,000 are employed by commercial airlines.

On this fiftieth anniversary of powered flight, tribute is paid to the genius of the Wright brothers and to the continued pioneering that is the spirit of the aviation industry.

School of aeronautical engineering at Cornell. The school's subsonic wind tunnel may be seen at the left.



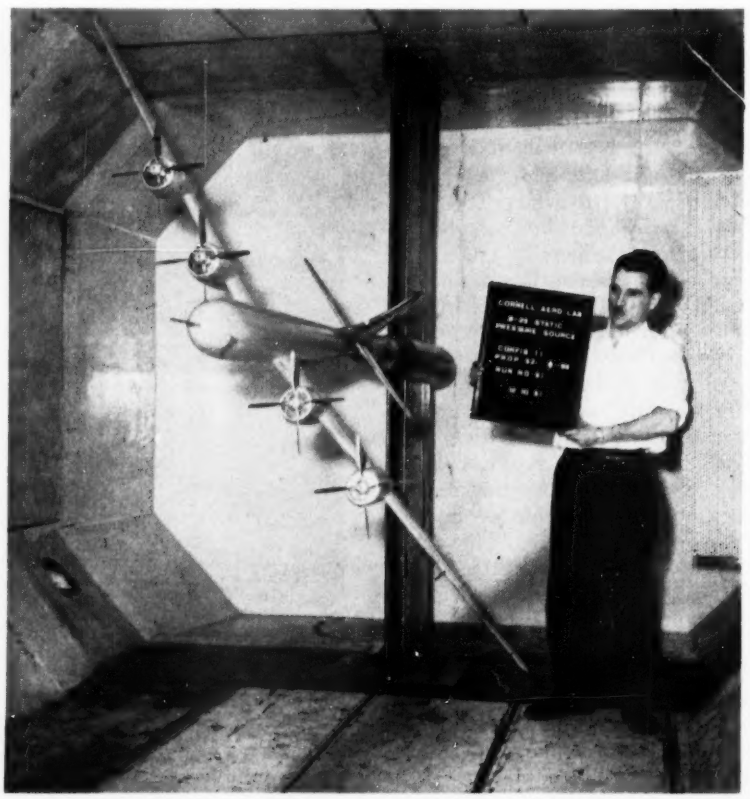
CORNELL AND CORNELLIANS HAVE CONTRIBUTED TO AVIATION'S PROGRESS

And what of Cornell's contributions to aviation progress? The advances made within the last decade are known to most students and alumni. In 1945, the idea of converting the Curtiss-Wright Research Laboratory in Buffalo into a public institution with university affiliation was presented to Cornell University; through the pledging of working capital by six eastern aircraft firms, the laboratory became a self-sustaining part of Cornell Research Foundation. Incorporation followed in 1948, and supervision was given by the newly-appointed Vice President for Research, Dr. T. P. Wright, one-time vice-president of the Curtiss-Wright Corporation. The laboratory has made significant contributions to aviation research and this spring boasted of approximately $14,000,000 in backlog contracts. Under the direction of Dr. Clifford C. Furnas, the Cornell Aeronautical Laboratory has well fulfilled its motto of dedication as "An instrument of service to the aircraft industry . . . to education . . . to the public at large."

The School of Aeronautical Engineering started operations in the fall of 1946, a few months before the Buffalo Aeronautical Laboratory became associated with Cornell University. The school began with a student body of twelve and a staff of five and reached its peak enrollment in 1952, with twenty-seven students registered. Professor W. R. Sears, director of the school, states that most aeronautical engineering schools have not turned out a brand of engineer equipped to handle "problems of high speed and high altitude met with in industry." He estimates that Cornell stands among the top three aeronautical engineering schools in the country. Upperclassmen in the various undergraduate engineering schools are able to include aeronautical courses among their electives; and many may receive a better education than those concentrating on aeronautical engineering elsewhere. Such students can obtain a master's degree in one year instead of the usual two.

Lesser known accomplishments of recent years have been the establishment of the Daniel and Florence Guggenheim Aviation Safety Center at Cornell University in September 1950 and the formation of the Cornell Committee for Transportation Safety Research in December, 1951. The objectives of the first organization are "to foster the improvement of aviation safety through research, education, training, and the dissemination of safety studies to the industry and of air safety information to the general public." With headquarters in New York City, the Center has directed work toward improvement in the design, operation, and performance of aircraft, of ground facilities, and of operational methods.

The latter committee was the outgrowth of the Cornell Air Safety Committee appointed by President Edmund Ezra Day in 1947. The present body is now concerned with automobile as well as aircraft safety and includes as members Dr. C. C. Furnas, director of the Cornell Aeronautical Laboratory; Dr. N. A. Christensen, director of the School of Civil Engineering; S. C. Hollister, dean of the College of Engineering; and Dr. W. R. Sears, director of the School of Aeronautical Engineering. Dr. T. P. Wright, Vice President for Research, serves as chairman. Research work is being done by the Cornell Medical College, by the Aeronautical Laboratory, and by the Psychology Department at the University.



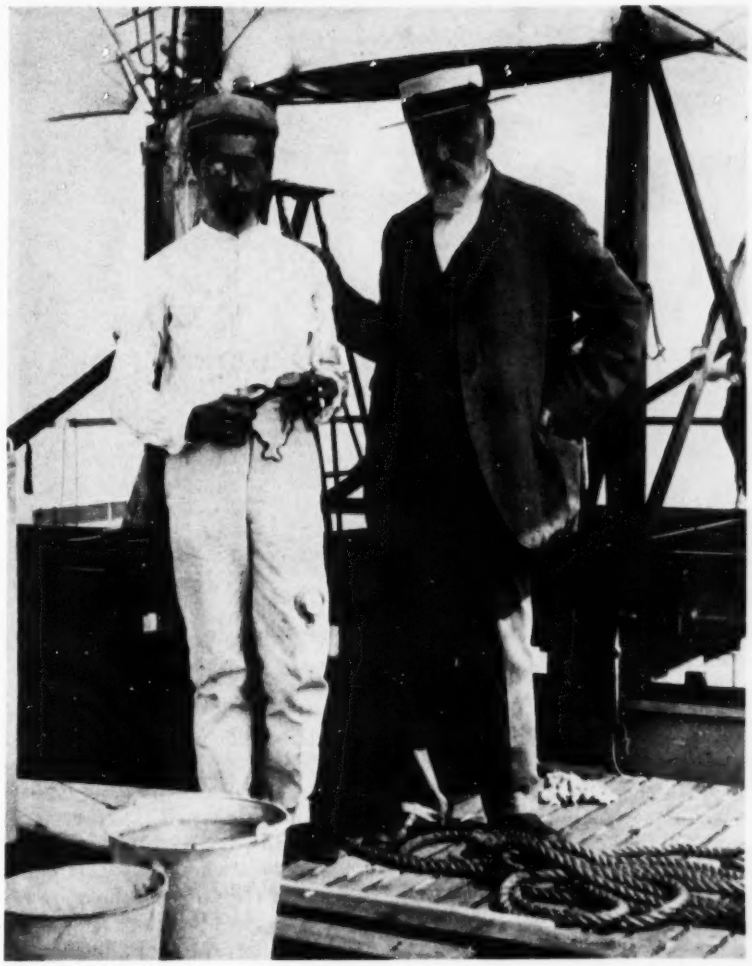
A scale model of a B-29 mounted in the throat of C. A. L.'s large wind tunnel. This detailed model has a wing span of over seven feet and weighs about 500 lbs. Its construction demanded three months effort by C. A. L.'s model shop.

—C.A.L.

Cornell University has played an important role in the early history of aviation through the contributions of men like Charles M. Manly, Sanford A. Moss, George William Lewis, and William F. Durand. This month we recognize the inspiration and leadership of these men and recount the stories of their contributions to aviation.

Charles M. Manly

Charles M. Manly, a Cornell graduate, ranks high among the pioneers whose persistence and genius made possible the development of powered aircraft. In the summer of 1898, Dr. Samuel P. Langley hired Manly to supervise the design and construction of an airframe large enough for a man-carrying aircraft. Dr. Langley had gained fame as a reliable authority on aerodynamics when he published the results of his experiments on the resistance of plane and curved surfaces to moving air-streams. Langley had constructed several flying models powered by steam engines and in 1896 flew a 260-pound machine a distance of 4,200 feet at thirty miles per hour. As a result of a request from President McKinley for a military flying machine, Dr. Langley enlisted Charles Manly as a personal assistant in the task of building a man-carrying airplane.



Charles M. Manly and Samuel P. Langley at the Potomac River site after their unsuccessful attempts at flight were made.

Manly attacked the problem of a structure for the machine by conducting a series of tests with small models. The results indicated that contemporary construction methods placed too much stress on materials and that difficulties in building a large aircraft would be encountered in that weight increased at a greater rate than did the effectiveness of supporting surfaces. As research and development progressed, several experimental flights in 1890 failed because of carelessness on the part of workmen, who, said Manly, "cannot be relied on in anything which requires that everything be done exactly right and not nearly right."

Actual flight tests of a full-sized plane were held up by lack of a workable powerplant. Mr. Manly accompanied Langley to Europe in 1900 in search of a manufacturer who could build a light powerful motor. After many had stated that it was impossible to build an engine of 12 horsepower to weigh less than 230 pounds, Charles Manly returned to the United States and built a five-cylinder, four-cycle radial engine that weighed only 207 pounds. His successful machine developed 52.4 horsepower with the use of twin aluminum flywheels. Langley's completed aircraft was 52 feet long with a 48-foot wing span. Built of steel tubing and cotton fabric and weighing 850 pounds, it transferred power from the engine to twin pusher propellers by use of bevel gearings.

Bad weather and repairs delayed the first flight until October 7, 1903. After Manly had climbed into the pilot's seat and the engines had been warmed up, the plane was released from its catapult. It shot forward and toppled into the Potomac, Manly being doused but unharmed. A failure in the launching mechanism was the supposed cause of the mishap.

Manly and Langley quickly rebuilt their plane, and on December 8, the machine was launched a second time. Although motor and propellers worked perfectly, the tail section collapsed as the plane was released and Manly was sent into the cold river a second time. After this second failure, the Army quickly withdrew its support, despite Manly's and Langley's efforts to explain their difficulties.

The unsuccessful attempt at powered flight by Manly and Langley met with severe public ridicule.

Sanford A. Moss in his study

It was suggested that Langley's plane needed an atmosphere for successful operation that was "a little denser than the intelligence of one scientist, but not quite so dense as that of two." However, Manly convinced his associates to continue work on the machine and solicited financial aid for the undertaking.

In 1914, eight years after Langley died disappointed at his failure, the airplane was flown at Keuka Lake near Hammondsport, New York. Glenn Curtis, in charge of the tests, replaced the catapult launching system with floats and substituted a shorter wing for the one damaged in the 1903 experiments. The flight was a success in spite of reduction in power by engine deterioration. The machine was later restored to its 1903 design and deposited in the Smithsonian Institution. Thus the work of Manly and Langley has received the recognition it deserved.

Sanford A. Moss

Leader in the group of scientists who developed the turbosupercharger, the design fore-runner of the modern turbojet power-plant, was the late Dr. Sanford A. Moss of Cornell University. He and a few others persisted in the belief that turbine blades could be designed which would not disintegrate at high speeds and succeeded in making the turbosupercharger a reality.

While at Cornell, Dr. Moss designed and tested a turbine powered by combustion products under pressure. He then developed a gas turbine supercharger compressor for high-altitude flight, his design incorporating the basic principle of present-day superchargers used in piston-engine airplanes.

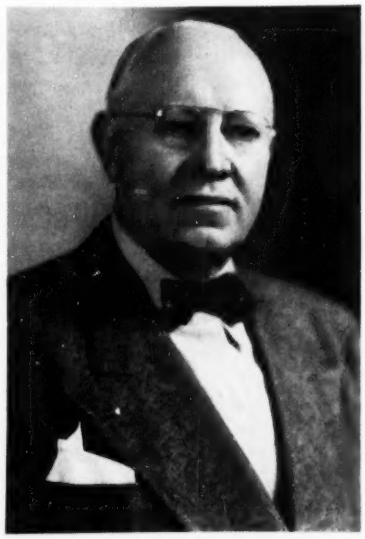
Dr. Moss tested his turbine on top of Pike's Peak in 1918. The 350-horsepower Liberty engine used in the experiment developed 230 horsepower without the supercharger and 356 horsepower with the supercharger attached. A year later the device was flight-tested to 18,000 feet and then to a record altitude of 33,160 feet. The success of the supercharger stimulated research to replace and improve upon its steel construction. General Electric Company, with Dr. Moss' assistance, conducted a development program in spite of reduced military appropriations.

Sanford Moss' accomplishment in the field of aircraft powerplants has made possible the increased efficiency of the airplane as a fighting weapon and has contributed to fast, comfortable passenger service in high-altitude commercial airlines.

George W. Lewis

George W. Lewis' achievements as head of the National Advisory Committee for Aeronautics have placed him among the leaders in aviation development. He became director of NACA in 1919 and held the position of Director of Aeronautical Research from 1923 until 1947. Under his guidance NACA grew from an organization with 43 employees to a research body with 6,000 members, these including many leaders in aviation. In implementing its purpose, "to supervise and direct the scientific study of problems of flight," NACA expanded from a small laboratory with one wind tunnel worth $5,000 to the present three major research centers valued at ninety million dollars.

A man of broad vision, Lewis pioneered in the development of research equipment. He was the first to use variable-density wind tunnels, refrigerated and full-scale wind tunnels, high-speed tunnels, and other new instruments of research. His designs contributed to propeller, power-plant, and seaplane development.



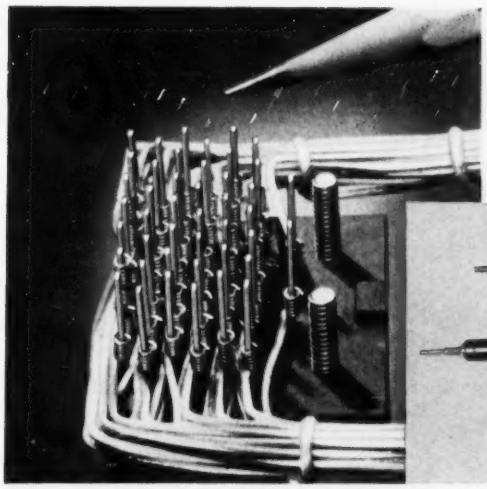
George W. Lewis

Lewis was a graduate of Cornell Sibley College. In his work for a

(Continued on page 55)

Good Connections

...electrically speaking



New solderless method permits the making of very closely spaced connections, as shown on this experimental terminal block.

Electrically powered "wire wrap" tool (above) and compressed air tool (below) for making wrapped solderless connections.

GOOD CONNECTIONS are mighty important to us for, you see, we make more than a billion electrical connections each year. It takes that many to manufacture and install complex telephone equipment in the Bell System.

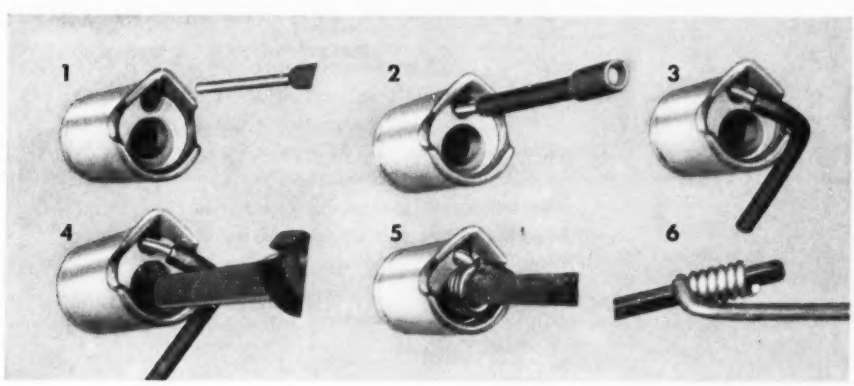
That's why the revolutionary new method of making electrical connections *without solder*—a method created by Western Electric engineers together with their teammates at Bell Telephone Laboratories—is indeed one of the significant engineering achievements of recent years.

Like most really creative engineering jobs, the development of a tool to make solderless connections grew out of a problem. We had to find a way to connect our newly designed wire spring relay to other components in giant bays of switching equipment. This new relay—something of an engineering achievement itself—can have as many as 36 terminals in an area only 1-3/8" by 11/16". Obviously, the conventional method of hand-wrapping and soldering wires onto the terminals is extremely difficult in such a small area.

After more than five years of research and experimentation, the engineers came up with a pistol-like power tool capable of making mechanically sound solderless connections. Shown above are two tools now used at Western Electric manufacturing locations. They literally shoot wire onto terminals . . . and do it surer, faster and less expensively than conventional methods using solder. That's not all. The new "wire wrap" tool keeps equipment free from solder splashes, wire clippings and reduces bent and distorted terminals. Electrically, the "wire wrap" tool gives a far better connection than can be made manually . . . the high pressure contacts are stronger, cleaner, more compact and more uniform.

In keeping with the Bell System policy of sharing technical know-how with all of industry, Western Electric will make this tool commercially available to electrical manufacturing companies, such as radio, television and communications producers, through licensed tool manufacturers.

You're right if you think we're more than a little pleased with our accomplishment. And as we have been many times before, we're proud of the engineers in all fields—electronics, mechanical, electrical, metallurgical, chemical, industrial—who uphold our reputation for leadership in fundamental manufacturing techniques.



How a solderless connection is made: (1) Skinned wire approaches the small flared opening in the tool tip. (2) Wire is inserted in hole. (3) Wire is bent and anchored by means of notch in side of gun tip. (4) Gun tip is slipped over rectangular wire terminal. (5) Spindle of gun tip rotates to wrap wire around terminal. (6) Six wire wraps around terminal complete electrically sound joint without soldering.

Western Electric

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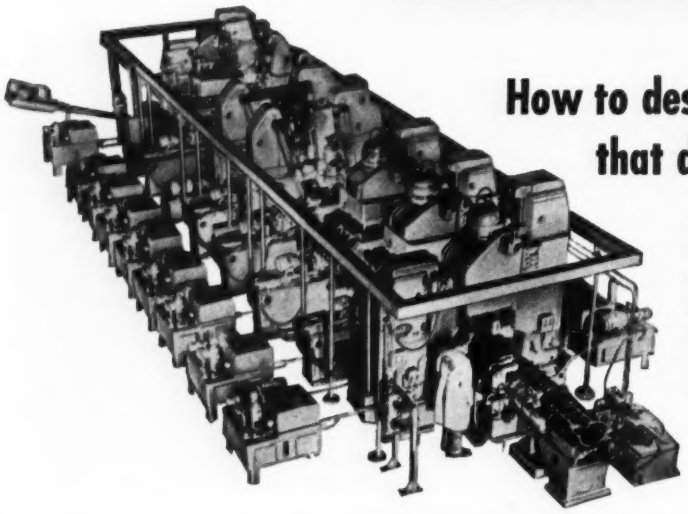
Another page for **YOUR BEARING NOTEBOOK**

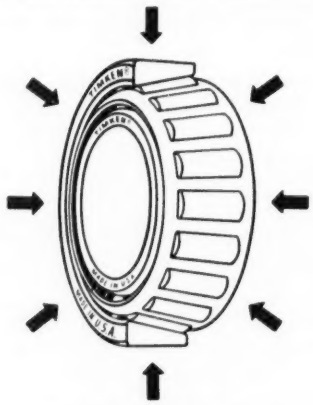


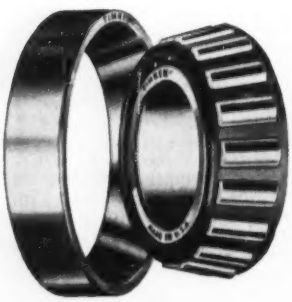
How to design precision into machine that does 98 operations a minute

In designing a machine that performs 98 facing operations every 1.1 minutes, machine tool engineers had to be sure of extreme precision in spindle shafts. Spindles had to be held rigid to eliminate vibration and chatter. Engineers solved this problem by mounting all spindle shafts on Timken® tapered roller bearings.

How TIMKEN® bearings hold spindle rigid

The line contact between rollers and races of Timken bearings gives spindles wide, rigid support. Deflection is minimized and end-play eliminated because the tapered construction of Timken bearings enables them to take radial and thrust loads in any combination. Spindles are held rigid for long-lasting accuracy.





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NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST —◎— LOADS OR ANY COMBINATION ✳

Aerial Photogrammetry

by DAMON G. DOUGLAS, C.E. '56

Precise surveying is done at a lightning rate with modern photographic techniques

Photogrammetry, the art of making measurements from photographs, is not a new development. As long ago as 350 B.C., Aristotle realized that images of the sun shining through a tiny square aperture were still round and that their size increased with increasing distance from the aperture. As has been the case with many scientific advances, aerial photogrammetry has been largely developed because of military demands. In 1852 an officer in the French Army Corps of Engineers found that through the use of perspective principles, topographic maps could be made from aerial photographs. Occasionally balloons and kites were used during the Spanish-American War to carry cameras for topographic mapping.

With the advent of the airplane, keen interest in aerial surveying began to rise. During the First World War, aerial photos were used to a rather large extent to determine the position of enemy installations. However, it wasn't until the Second World War that photogrammetry came into its own. Improvements in films and camera design have led to a fantastic enlargement of the uses of photogrammetry.

Applications of Photogrammetry

With photogrammetry, inventories of every description can be made from photographs. The volume of timber and species composition as well as other valuable information about forests can be obtained. Soil and mineral conditions may be determined from land forms and vegetation types. When used in connection with a magnetometer, aerial photographs have discovered rich ore and oil deposits of all types which had been previously hidden to ground prospectors. Water inventories of a particular watershed have aided the planning of dam sites. Conservationists even go so far as to count wild life in park areas using this method.

It has been estimated that over 90 per cent of the mapping done today is being done with the aid of aerial photos. In 1951 The United States Geological Survey hired 3000 persons to produce maps from aerial photos. The Army Map Service of the Corps of Engineers, reportedly the country's largest map making outfit, employs even more. In 1950 a prominent Philadelphia concern operated a 5½ million dollar business on information gained from aerial photos. However, even with all these fields in which air photos are applied, presently more and more uses are being found. The industry is growing like Jack's magic beanstalk.

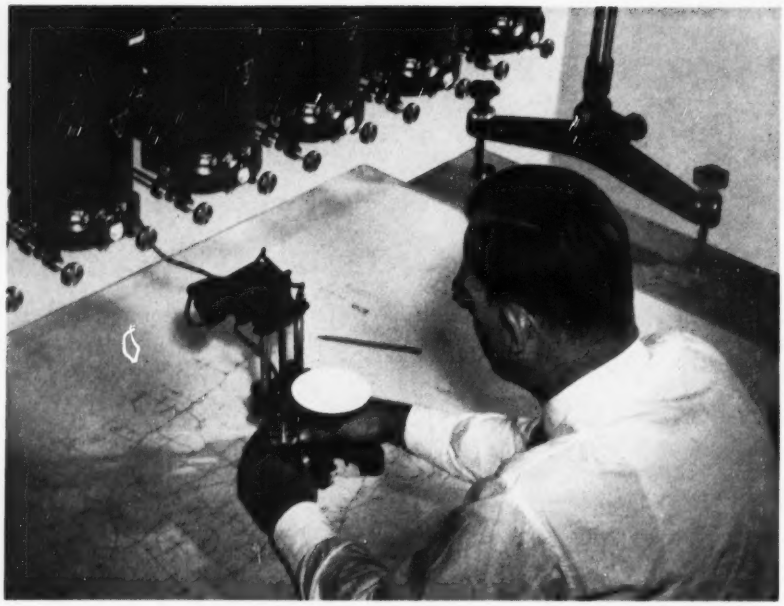
Stereoscopy

The principles of stereoscopic vision as used in three dimensional moving pictures are basic to photogrammetry. Most of the mapping and a good deal of inventory work is facilitated by the use of the third dimension.

The eye is an amazingly accurate measuring device. Two eyes working together automatically record the angle formed by two rays emitting from a point source. From precalculated tables, the brain unconsciously registers the distance to which that angle corresponds. Angles as small as twenty seconds or distances of approximately 2000 feet can be distinguished by a normal pair of eyes.

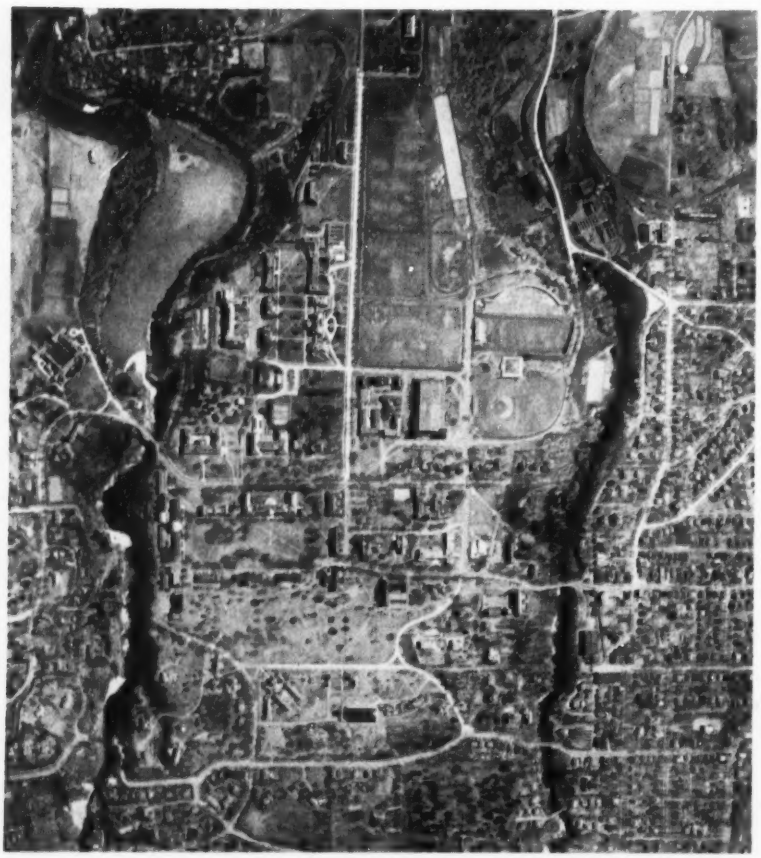
To produce three dimensional maps an airplane flys from anywhere near 100 feet to 40,000 feet and photographs a succession of pictures of the ground. The pictures are overlapped by as much

Cornell students studying stereoscopic aerial photographs. Some of the instruments shown are simple aids to visual examination of stereo photographs, others include apparatus for the precise measurement of elevation differences or for direct contour plotting.



—*Bausch & Lomb*

Multiplex projector in operation. This machine uses the two-color principle of steroscopic projection for the construction of topographic maps.



Aerial photograph of Cornell campus from survey of 1944. The photograph was taken from 9,600 feet, but even the stripes on the football field, left center, are visable. Rapids may be seen at the end of Beebe Lake, lower right. The depth of the two gorges is shown by shadows, particularly that of the bridge, center right.

as 60 per cent so that an interpreter will have at least two views of the surface to be mapped. By looking at one picture with one eye and the next picture with the other eye, the observer sees a relief or 3-D representation of the ground.

Aids to 3-D Vision

To look at one photo with one eye and another with the other eye requires some degree of skill. Experienced workers can train their eyes to look divergiently at two photos. Several techniques have been developed in order to make stereoscopic vision easier to realize. Instruments similar to old fashioned stereoscopes are probably the most widely used. Here mirrors or lenses diverge the rays from the source making the distance angle greater. A device called an anaglyph is of considerable importance to firms that do extensive mapping. Two transparent positives of an area are projected onto a drawing board; complementary colors, such as red and blue-green, are the light sources. Spectacles are worn which have one side red and the other blue-green. Since the eye with the red lens can not see the blue image, and vice-versa, each eye sees one image and their combination gives a stereoscopic effect. Instruments called vectographs use polarized light at right angles to give the same type of relief. Another old system is the German-developed "Blinkers." The two stereoscopic images of an area are passed in succession on a rotating disk. A set of eyeshades operating in phase with the revolving disk covers one eye at a time. Thus each eye sees only one picture and the combined effect is three dimensional.

Through the proper use of these aids to stereoscopic vision, it is only a slight problem to find differences in elevation between two points. Contours can be drawn rapidly. Features become easily recognizable and are readily plotted.

Recent Developments

Aerial photographs are classified as "verticals," if the axis of the camera is perpendicular to the ground, or "obliques," if the axis is not perpendicular to the ground Although pictures nowadays are usually taken by single-lense cam-

eras, a multi-lense camera taking as many as eight obliques and one vertical can be used. For most projects it is desirable for individual pictures to cover the largest ground area possible (i.e. be taken from as high an altitude as possible.) This is limited, however, by the desire for maximum ground detail and a large scale, which are achieved by taking photos at low altitudes. In an effort to gain all three qualities at once, photographers have turned to cameras with longer focal lengths. Twelve inches is a common length, while a non-airborne camera with a focal length of 100 inches has been tested. Experts foresee cameras with focal lengths of 400 inches or more.

A relatively new development is that of Image Motion Compensation. Basically the principle is to leave the shutter open and move the film with relation to the lense so that a given point on the film remains optically opposite the same point on the ground. Image Motion Compensation (IMC) can be applied to either individual frames or, more commonly, to continuous strips. This sort of photography is particularly useful at low altitudes and high speeds. A picture of a jet taken by a camera in another jet several hundred feet below—while both were flying close to the speed of sound in opposite directions—showed clearly every detail down to the rivets.

Strip photography is especially practical in highway construction. A plane flying the length of the route can collect more data in twenty minutes than a surveying party could in several weeks.

Color photography has been used to good advantage on special projects, but because of the extra cost and added care required, black and white remains the most popular processing. During the last war the Army occasionally took aerial photos at night with the aid of large flash units. The advantage of the flash unit, non-militarily speaking, is its ability to reveal detail behind shadows.

Radar in Aerial Mapping

A development for the future has been outlined by Prof. William T. Holser of the Geology Department at Cornell. In a recent patent, Holser describes the use of radar in plotting contour maps. Attached to a standard radar set would be a device for singling out responses from a given elevation. The locus of the points of this elevation appear as the actual contour line which may then be photographed in a routine manner. As radar is only slightly affected by clouds, this method would have a great advantage over conventional photography which has the weather element to contend with. However, radar could not compare with aerial photography with respect to accuracy. Nevertheless, Prof. Holser feels that in years to come, when the diameter of the radar transmission beam has been made smaller, and thus its fidelity increased, his system will take on practical value.

Each year problems of completely different character are encountered by the mapper. How do you obtain accurate ground control from the air? How can you prevent shrinkage of photographic paper, which changes the scale of the map? How do you best minimize the effects of tilting? The extent to which these problems are answered will be a measure of the growth of the industry in the succeeding years.

Brain Teasers For December

The Cornell Engineer is offering three dollars to the first person who mails us the correct answers to all of the problems listed below. In general, the puzzles require every little paper work but a good deal of ingenuity and can be handled by anyone with a knowledge of high school math.

*1. Find the price of eggs if two eggs for thirty cents raises the price two cents per dozen.

2. A man invested three equal sums of money on sheep, calves, and hogs, respectively. Each calf costs three dollars more than each hog and six dollars more than each sheep. The total number of animals was thirty-seven. The number of sheep exceeded the number of calves by as many as the number of hogs that could be bought for seventy-five dollars. Fnd the total amount of money the man invested for all the animals.

*We give you our word of honor that this isn't doubletalk.

3. What are the odds against drawing a straight flush in a five card draw with the deuces wild.

The winner of the October puzzle contest has been determined. He is Mr. Herbert Koppel of 1500 West Terrace Circle, West Englewood, New Jersey. Mr. Koppel, an electrical engineer, is currently a project manager in the H. L. Maxson Corporation in New York City.

The answers to the October Brain Teasers are:

2. $1.17060 = \log_{10}15$.

2. 2.

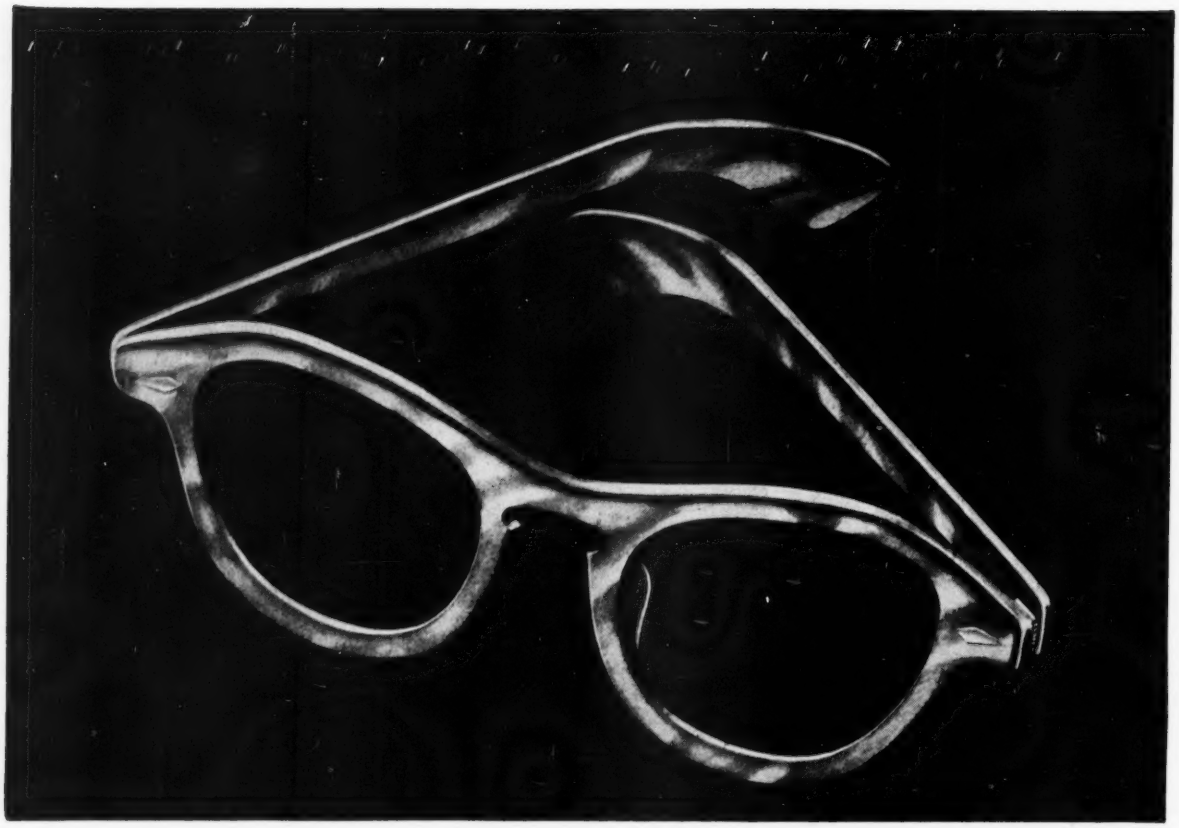
3. The monkey is 1½ years old.

The answers to the November Brain Teasers are:

1. Three children.

2. 5 5/12.

3. The probability of success is 0.6365.



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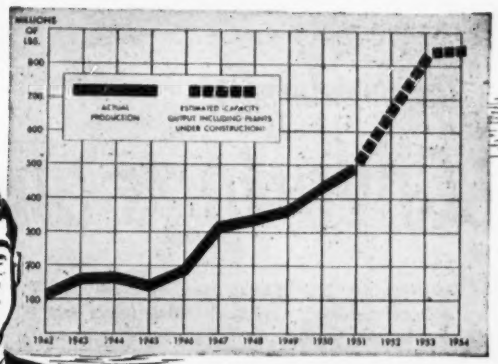

Reynolds expanding production —historic chapter in 33 years of continuing growth.

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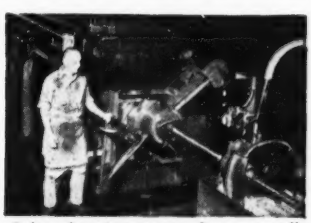

Tube drawing, one of many mill operations at Reynolds

A broad vista of opportunity opens up for college graduates who come to work for Reynolds. The phenomenal rise of the Reynolds Metals Company, known throughout business and industry, is clearly depicted by the above chart. The five-fold expansion in total production of aluminum ingot alone spells broad opportunity. Add to this the vast and productive fabricating facilities of Reynolds —in themselves an enterprise of considerable proportions—and here indeed is a fertile field for any ambitious engineer.

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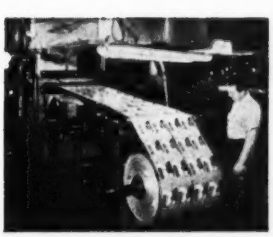

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NO. 4 IN A SERIES

The Importance of

Coverings and Sheaths for

THE TERM "COVERINGS", as applied to insulated electrical wires and cables, refers to a relatively continuous homogenous layer or layers of impervious and inert material, applied over an insulated conductor or conductor assembly for the purpose of protecting such conductors from moisture, chemical attack and mechanical damage. Coverings may be colored to indicate circuit identification. Chemical attack refers to damage to the insulation resulting from acid, alkalies and other chemicals in the atmosphere or the ducts or soil in which the cables may be installed. Mechanical damage may result from the abraiding, compressing, cutting and tearing forces to which the insulation may be subjected during installation and service.

Coverings may be made of metallic or non-metallic materials. Metallic coverings may be, (1) a continuous metal tube over the insulated conductor, usually made of lead and known as a lead sheath, (2) metal tapes applied spirally about the insulated conductor and referred to as an armor or a shield, depending on the purpose for which it is used, or, (3) metal wires applied spirally either in one direction or in the form of a braid, and again known as an armor or a shield. Armor is a covering applied primarily for mechanical protection or to add strength while a shield is applied to protect the insulation from electrical stresses or for safety purposes. Non-metallic coverings may consist of, (1) a continuous layer of vulcanized rubber or rubber-like material, generally neoprene, or a thermoplastic material, called a jacket, (2) spirally applied, moisture-resistant fibrous yarn, usually cotton or jute, (3) moisture-resistant fibrous tapes, or, (4) moisture-resistant fibrous braids. Combinations of one or more of these may be used as explained later.

The kind and number of coverings used is determined largely by the size of the conductor or cable, the type of insulation on the conductor and the installation conditions. The following is a brief outline of the types of coverings required for the more important types of insulations and installation conditions.

INSTALLATION in DRY CONDUITS and DUCTS

Single-conductor rubber and varnished-cambric insulated cables require a covering over the insulation consisting of a moisture-resistant cotton braid on the small sizes and a double braid or tape and braid on the large sizes for protection against mechanical damage. On 600 volt cables for installation in buildings this covering must be flame-resistant, and is usually colored for circuit identification. A thin layer of neoprene may replace such fibrous coverings on rubber-insulated cables. Paper-insulated cables require a lead sheath for retention of the impregnant and for mechanical protection. Single-conductor polyvinyl chloride insulated cables usually require no coverings since they are generally considered resistant to flame and chemical and mechanical damage.

Multiple-conductor cables which consist of two or more single conductors assembled as a unit are protected by an outer covering. The individual conductors of multiple-conductor rubber insulated cables are generally protected by a single fibrous covering. The outer covering of multiple-conductor cables usually consists of a tape and moisture-resistant cotton braid on rubber and varnished-cambric insulated cables. A neoprene jacket may replace the outer braid on rubber-insulated cables. A polyvinyl chloride jacket is generally used on polyvinyl chloride insulated multiple-conductor cables. Multiple-conductor paper-insulated cables have a lead sheath over the assembled insulated conductors.

INSTALLATION in WET CONDUITS and DUCTS

The coverings described for use in dry locations on both single- and multiple-conductor cables are suitable for use in wet locations except that a lead sheath is required over varnished cambric and non-moisture-resistant rubber and polyvinyl chloride insulations.

Moisture-resistant rubber insulation requires mechanical protection in the form of a fibrous covering or coverings or a neoprene jacket. A neoprene jacket is preferred because of its greater resistance to deterioration in wet locations. Moisture-resistant polyvinyl chloride may be

insulated wires and cables

used without a covering on single-conductor cables.

AERIAL INSTALLATIONS

The types of coverings described for use in wet locations are generally suitable for aerial installations but greater thicknesses of non-metallic coverings, particularly for single-conductor cables, are required. Fibrous coverings for aerial use are usually made of moisture-resistant jute, sisal or loom-woven cotton of large size. Neoprene jackets on single-conductor cables for aerial installations are about 50 per cent greater in thickness than those used for duct installations. These thicker covers provide the additional mechanical protection required for aerial installations. Neoprene jackets are generally preferred over fibrous or rubber jackets because of their greater resistance to weathering. Lead-sheathed cables with the same sheath thickness as used for duct installations are suitable for aerial installations. A lead alloy containing small amounts of antimony or tin is used instead of pure lead to reduce failures due to crystallization.

DIRECT BURIAL

For direct-burial installations, rubber, rubber-like or thermoplastic jackets and lead sheaths are generally used. The jacket or sheath thicknesses are the same as those used for aerial installations. Lead sheaths require protection against mechanical damage. This usually consists of two servings of moisture-resistant jute yarn immediately over the lead followed by two steel tapes over which are applied two servings of moisture-resistant jute.

SUBMARINE and VERTICAL CABLES

Submarine cables require protection against mechanical damage and additional strength over that provided by the conductors to prevent them from being broken by dragging anchors or other objects. Vertical cables frequently require greater strength for their support than that provided by the conductors. This additional strength and mechanical protection is usually provided by a serving of steel wires which completely covers the surface of the cable. This is known as a wire armor. A bedding consisting of two moisture-resistant jute servings is provided between the non-metallic jacket or lead sheath and the armor wires.

PORTABLE INSTALLATIONS

Cables for portable installations such as those used on dredges, shovels and mining equipment must be flexible and their sheaths must be resistant to abrasion, cutting and tearing. Tough wear-and-weather-resistant rubber or rubber-like jackets are therefore used. Such jackets are generally made in two layers with a reinforcing braid of high-strength cotton yarn between them. The jacket thicknesses for such cables are generally greater for a given size of cable than those of cables for non-portable installations.

SHIELDING

Shields consist of one or more conducting layers on insulated electric power cables, the purpose of which is to confine the dielectric field to the insulation on the individual conductors. The two most important functions of shields are, (1) to protect the insulation against harmful electrical stresses and discharges at its surfaces, and, (2) to reduce hazards of shock.

Since harmful electrical stresses can occur at both the internal and external surfaces of an insulation, particularly on stranded conductors, at high voltages, it is necessary to provide shields at both surfaces. Internal shielding in the form of a semi-conducting fibrous material is generally used immediately over the conductor for operating voltages above 2000. External shielding usually consists of a semi-conducting fibrous layer immediately over the insulation over which is applied a layer of metallic material. External shields are generally used at voltages above 3000 for non-metallic jacket cables and above 10,000 for lead-sheathed cables.

Metallic shields are made of non-magnetic materials such as aluminum or copper and are applied as tapes on cables for non-portable installations and as braids for portable cables. External shields must be grounded at all joints and terminals.

For reprints of these pages write to address below.

Electrical Wire and Cable Department
Rockefeller Center • New York 20, N.Y.

CORNELL SOCIETY OF ENGINEERS

Thomas W. Hopper

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish closer relationship between the college and the alumni."

REGIONAL EXPANSION OF THE SOCIETY

The Cornell Society of Engineers is growing consistently in size, strength and influence. This growth is aided substantially by individual participation in regional branch meetings. Such meetings may be planned for promoting the interests of the Engineering College and may have as the principal speaker a representative from Ithaca; or they may be assembled to discuss an outstanding industrial achievement, the main address being presented by a prominent engineer or industrialist, preferably a Cornellian.

Since our members are called upon to attend meetings of many varied groups, it would probably be unwise to hold monthly meetings of the Society. In our largest regional branches, from two to four meetings during any year are sufficient for our needs. A single, well-planned meeting each year should be most effective for the smaller areas.

There are approximately eighteen thousand Cornell engineering graduates, of whom thirty-five hundred are members of our Society. These members are widely distributed throughout the United States and foreign countries. Approximately two thousand members reside in large metropolitan areas already served by branches of the Society. There are other areas in which the limited concentration of Cornell engineers does not warrant a separate branch, but where the Society should be represented in order to further the interests of the College of Engineering and its graduates. Areas in and around Baltimore, Washington, Pittsburgh and Cleveland, for examples, should have direct contact with the Society through a representative who would assure that one outstanding engineering meeting was held each year.

The suggestion has been made that we enlist the cooperation of the local Cornell Clubs in such a program of expansion. Under this plan, the president of the local Cornell Club would appoint an active member of his club, preferably one of the directors, who is also a member of our Society, to be our representative. He would automatically become an officer of the Society and would handle all Society matters for his area. His main responsibility would be to select a local committee of engineers to plan and conduct the annual engineering meeting for that particular Cornell Club. The Society would provide a list of its members in the area and would pay the promotional and mailing costs incurred by the meetings so arranged.

Our Society has the single purpose of promoting Cornell engineering on a national plane. It is not our intent to assume any of the functions of local clubs in the operation of our regional branches. We encourage our members to join their clubs and provide strong suport in their operation.

ALUMNI ENGINEERS

Charles Worthington Comstock, M.C.E. '94, Ph.D. '98, died September 18, 1953 at Denver, Colorado. In addition to receiving his doctors and masters degrees at Cornell, Mr. Comstock served as an instructor in civil engineering at Cornell from 1890 to 1897. In his varied experience in mining and civil engineering, Mr. Comstock held such positions as: Professor of Mining Engineering, Colorado School of Mines; Practicing Civil and Mining Engineer; State Engineer, Colorado; and Consulting Engineer, South Pacific Division, U. S. Engineer Department. He also worked for the Electrical Bond and Share Co. and Hercules Powder Co.

A. Yates Dowell, Jr., M.E. '42 is practicing law in his father's office in the Munsey Building, Washington 4, D.C. He studied law at George Washington University.

Herbert B. Reynolds, M.E. '11, M.M.E. '15, who has been with J. G. White Engineering Corp., New York, since his retirement in 1949 as superintendent of power generation, N.Y. City Transit System, has left J. G. White and will devote time to technical writing and consulting work. Herb is a Fellow of both ASME and AIEE and is a member, Engineers Club New York.

Leo A. Dunbar, M.E. '14, died July 30, 1953. In the years after his graduation, Mr. Dunbar remained in close contact with Cornell, especially the Engineering College.

George C. Wallace, C.E. '31, is President for 1953 of the Hawaii section of the American Society of Civil Engineers. He is also operations officer of the Territorial Civil Defense Agency and in charge of the division of sewers of the City and County of Honolulu.

William W. Robertson, M.E. '17, purchased the Oldsmobile dealership in Bradford, Pennsylvania. His address is 127 Kennedy Street, Bradford, Pennsylvania.

Laurence G. White, E.E. '28, of Silver Spring, Md., is a manufacturers' representative with offices in Silver Spring, Baltimore, and Winston-Salem, N.C.

Gerald K. Hollenbeck, M.E. '29, is an industrial engineer with the major appliance division of General Electric Co. which is presently under construction at Appliance Park in Louisville, Ky.

William S. Roberts, C.E. '32, of Redwood City, Cal., was presented with an emerald service emblem at a recent luncheon in recognition of his twenty years with Shell Oil Co. His address is Redwood City is 2428 Whipple Avenue.

Robert B. Seidel

Robert B. Seidel, E.E. '48, has been appointed director of research and product development for Safety Car Heating & Lighting Company, Inc.

Warren Bohner, M.E. '38, has been named manager of pricing at Caterpillar Tractor Co. in Peoria, Ill.

A son, Michael John, was born, June 30, to **Frank N. Rothwell, C.E. '42.** Rothwell left his partnership in Rothwell & Lester, architects & engineers, last April 1, to buy the South Pacific Contracting Co., Ltd. His address is 3288 Pacific Heights Road, Honolulu, Hawaii.

Sidney Lee, Ch.E. '40, of Dallas Laboratories, Consultant Engineers, was the guest of Governor Johnston Murray and Ray Turner of Oklahoma at the opening of the Oklahoma (Turner) Turnpike between Tulsa and Oklahoma City.

Lawrence R. Bollinger, M.E. '45, B.M.E. '45, is in the guided missles department of General Electric Co. in Schenectady. The former Alumni News photographer writes that "Most of my photographic efforts lately have been concentrated on our two sons, David, 3, and Richard, 5 months (and their mother, of course)."

Jerrier A. Haddad, E.E. '45, has been promoted to manager of the IBM Engineering Laboratories, responsible for IBM and defense engineering at Endicott. He was formerly manager of component development for IBM at Poughkeepsie and was concerned in the development of the IBM 701, electronic data processing machine.

Miss Vonda de H. Mac Closkey, C.E. '46, has been working for the past 18 months on the Air Base Construction Program in Morocco. In August '53 she was a member of the 3rd International Conference on Soil Mechanics and Foundation Engineering in Zurich, Switzerland, and is now vacationing in Europe.

Howard Sanders, B.S. in Chem.E. '44, M.Chem.E. '47, is associate editor of the Chemical and Engineering News, Industrial and Engineering Chemistry, and Agriculture and Food Chemistry, publications of the American Chemical Society. He now resides at 86-11 Thirty-fourth Avenue, Jackson Heights, New York.

Richard C. Lanigan, C.E. '49, Box 431, Stamford, Conn., has returned to his job with Peckham Road Corp. in White Plains after serving two years in the Army.

John P. Frasor, C.E. '47, Ph.D. '49, has been in Houston, Texas, visiting the Shell Oil Co. production Department on a training assignment. He is a corrosion engineer.

Robert T. Harnett, B.M.E. '48, B.E.E. '47, is working on a large electronic analogue computer installation in the computation branch of the Aeronautical Research Laboratory, Wright-Patterson Air Force Base. He lives with his wife at 556 Telford Avenue, Dayton, Ohio.

LeRoy C. Norem, C.E. '48 a field engineer in the Pittsburgh erection department of Bethlehem Steel Co., has announced the birth of a son, Paul Andrew.

Second Lieutenant Terance B. Blake, M.E. '51, has been a project engineer at the Wright Air Development Center at Wright Patterson Air Force Base, Dayton, Ohio, since August, 1952.

Robert M. Kleinberg, B.M.E. '49, helped erect the first frozen food plant in Northern Brazil. He is part owner of this American owned plant, **Sociedad Nacional de Alimentos Congelados,** which specializes in frozen shrimp and fish. His address is Caixa Posta 1203, Sao Luiz, Maranhao, Brazil.

Lt. James E. Geary

Second Lieutenant James E. Geary, Jr., M.E. '51, First Ordnance Co. (DS), APO 909, c/o Postmaster, San Francisco, Calif., is a maintenance shop officer in Korea.

Edgar N. Bernhardt, Jr., M.E. '49, has announced the birth of a son. He is assistant superintendent of maintenance at the Warner Co. Van Sciver Plant.

Charles R. Mischke, B.S. in M.E. '47, M.M.E. '50, was appointed assistant professor of mechanical engineering, this June, at the University of Kansas, in Lawrence.

John P. Jaso, Jr., C.E. '50, and his wife **(Miriam McCloskey) '50** have a son, John Paul III, born May 4. Jaso, who was discharged from the Navy June 1, is working for Lincoln Electric Co. in Sleveland, Ohio.

David Blauvelt, E.E. '50, M.E.E. '53, a development engineer with Sperry Gyroscope Co. Great Neck, married Anita Van Hassel '51 on June 20.

Howard A. Acheson, Jr., B. Chem. E. '51, completed eleven months in Army Ordance in Korea and is now in the technical service department of Esso Standard Oil Company. He lives at 202 North Lehigh Avenue, Crawford, New Jersey.

William R. Parlett, Cornell '48, Sets Sights on Executive Sales Job

BILL PARLETT has learned that helpful engineering suggestions promote good customer relations.

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You'll find Boeing a stable 37-year-old company, that has grown practically continuously. For example, Boeing now employs 6000 engineers in contrast to 3500 at the peak of World War II. And although Boeing is a large concern, it is so organized that each engineer is an individual who stands out—and progresses—in proportion to his ability.

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Boeing Airplane Company, Seattle 14, Washington

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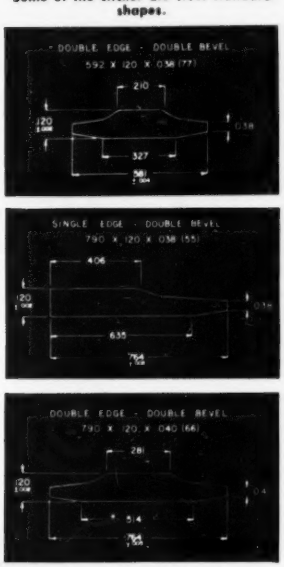
about clicker die steel

what it is

Clicker die steel is a special cold rolled alloy steel. It is used in making clicker dies for cutting leather, rubber, plastic, felt and fabrics of other compositions that go into the making of shoes and similar products.

Finished clicker die ready for cutting shoe leather.

Some of the clicker die steel standard shapes.



Wider shapes are used when dies are sized by surface grinding after forming and welding. Standard widths are provided when the dies are not to be surface ground.

how it is used

Clicker die steel is furnished to the die maker in either single or double edged form in one of several standard shapes. The die maker first shapes the die by bending the die steel to a pattern that provides the desired configuration, and then welds the two ends at a corner. He finishes the die by grinding a bevel on the outside of the cutting edge and filing the inside edge. Before the finished die is hardened and tempered, the die maker forms identification marks — combinations of circles and squares — in the cutting edge so that the material cut from it may be easily identified as to its size and style.

In the cutting operation, the leather or other material is placed on an oak block in the bed of the clicker machine. Then the die is placed by hand on the material which is cut as the aluminum faced head of the machine presses the die through it. The clicking sound which the head makes as it strikes the die is where the term "clicker machine" derived its name.

what it is composed of

Clicker die steel as produced by the Crucible Steel Company of America is a controlled electric steel in which the combination of carbon and alloy is designed for maximum toughness and proper hardness after heat treatment.

Experience has proved that cold finished clicker die steel is superior to hot rolled material for sizes approximately ¾ inch and narrower because of its lower degree of surface decarburization which permits the use of slightly thinner sections. Cold finished material also has a better surface finish with closer width and thickness tolerances and thinner edges that require less grinding and filing to complete the die.

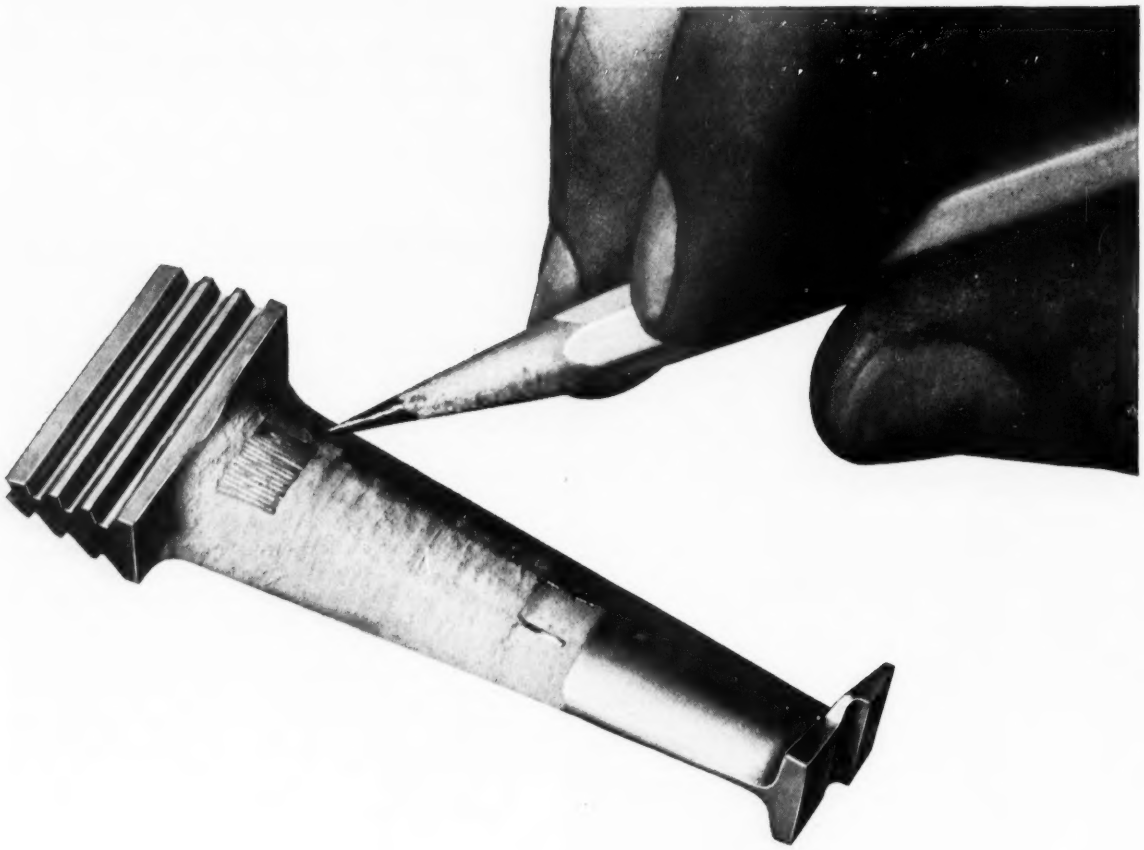
CRUCIBLE'S engineering service

As with clicker die steel, the Crucible Steel Company of America is the leading producer of special purpose steels. If you have a problem in specialty steels, our staff of field metallurgists with over 50 years experience in fine steel making is available to help you solve it. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin



important wire on a hot subject . . .

Even at temperatures of 1500° — speeds of 12,000 rpm — this tiny wire grid reports to our engineers on the strains in jet turbine blades. It gives them accurate measurements for calculating stresses caused by resonance and flutter.

This basic information, in turn, permits the design of blades that combine the optimum aerodynamic characteristics with structural integrity.

Strain gages are not new. But our engineers had to advance the art considerably to get readings at these high speeds and temperatures. It required the development of improved cements, instrumentation, slip rings . . . new application techniques and calibration curves.

Nothing can be left to chance in the design of aircraft engines for supersonic flight. Thus we use — and frequently improve on — every advanced technique and engineering tool. This straight-forward approach to engineering problems is one of the reasons many outstanding engineering graduates decide on a career at Pratt & Whitney Aircraft.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

East Hartford 8, Connecticut

PROFILE

—Photo Science

Tom Tracy coaching a member of the Glee Club

Tom Tracy Singing Engineer

By Thomas Reed, ME '56

In the fall of 1927 the freshman class of the Sibley School of Mechanical Engineering contained the usual number of men who would later make their mark in the world in fields far removed from engineering. Of these, impossible to identify and unknown even to themselves, one was to return to Cornell after a brief fling at engineering to assume the leadership of a fine men's glee club that has become a tradition at Cornell.

Upon graduation from the M.E. school in 1931, Tom Tracy secured an engineering position with a gas company on Long Island. A few years later he became a salesman for a prominent chemical company, but in 1936 he returned to Cornell to instruct courses in drafting, engineering, and heat-power in the hotel school. Soon after his return to the campus he began assisting the late Mr. Eric Dudley in directing the Men's Glee Club to which he had belonged and contributed so much during his undergraduate days. When the war broke out he participated in the Navy's V-12 program, teaching a course in diesel engineering as well as refrigeration and air conditioning. While so doing, he also earned his masters degree, majoring in refrigeration and and temperature measurement under Professor Mackey. However, in the same year that Mr. Tracy received his masters degree, the Glee Club found itself in need of a director. Since Mr. Dudley's retirement in 1942 the club had been under the University Music Department. Two directors had come and gone, and due to the untimely death of the latter of these in the fall of 1946, Tom Tracy was offered the position of director of the Men's Glee Club. Following this fortunate decision, musical success came quickly. In 1950 Mr. Tracy began devoting his full time to music; the degree Kelvin was a thing of the past.

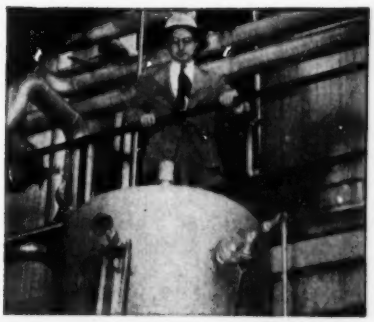
Since beginning his job as director of the Men's Glee Club he has become the leader of the First Presbyterian Church Choir and the Women's Glee Club. He organized the freshman glee club, better known as Orpheus, through which

all applicants for the Glee Club must pass. In the fall of 1949 he organized the Cayuga's Waiters, a triple quartet that performs not only at Glee Club shows but at local hospitals, banquets, and other campus functions throughout the year. Last fall he initiated the Cornellaires, a mixed group resembling the "Waiters." He is in part responsible for this fall's fine Savage Club show, and in addition to the formal directing he does, he has a large group of voice students.

Mr. Tracy's musical education might be called informal, but it has been thorough and effective. He commenced at the age of seven with piano lessons, but soon mastered other instruments as well, such as the clarinet and the baritone horn. He started training his voice at Cornell and was an outstanding soloist with the Glee Club during his years as a student. When he returned to Cornell he took a few courses in the Department of Music and thus gained most of his knowledge of theory. At the same time he began to study more seriously with Mr. Dudley and by the time he accepted the directorship of the Men's Glee Club had acquired a good background and an overwhelming voice that was and is still able to drown out the entire club decisively.

Today Tom Tracy enjoys the devotion of a successful glee club. Spring Vacation will see the club tour Mexico and the West coast to benefit local Cornell scholarship funds, a far cry from the first trip to Trumansburg in 1880. Defying all the clichés concerning narrow engineers, he has already taken a significant place in Cornell history with his shows that have brought entertainment to hundreds of thousands of undergraduates, alumni, and miscellaneous music lovers alike. He is a young man with a fine future. His laurels have been won in Bailey Hall and not in the Mech Labs, but Thomas B. Tracy, M.E. '31 is a man whom the College of Engineering may be proud to claim as its own.

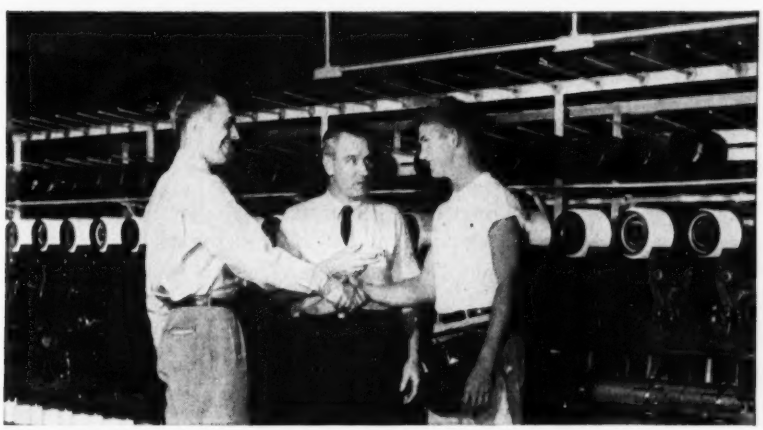
THE DU PONT DIGEST



George B. Bradshaw, Jr., *B.S. Ch. E., M.I.T., Asst. Supt., inspects a unit used in ammonia synthesis operation.*

Production Supervision

Requires Knowledge of Materials, Machines, and Men



Wm W. Kinsley, *M.S. in M.E., Penn. State 1949 (left), production supervisor in Du Pont textile fiber plant, is introduced to new operator by foreman.*

Keeping production rolling in a modern industrial plant is a job that appeals to men trained in many branches of science and engineering. If you are looking for opportunities in this field, you won't have to look far at Du Pont, where more than 1,500 members of the technical staff are engaged in production supervision.

To qualify, a man must be able to understand both the mechanical and chemical phases of production. In addition, he should be a good planner and, above all, have a knack for working with others.

Production supervisors are responsible for care of plant facilities, supply of raw materials, supervision of operation and maintenance, cost and shipment of finished products, as well as personnel relations, training and safety.

Since Du Pont makes over 1,200 products and product lines, it can offer many opportunities in a wide variety of operations to men interested in production supervision. In Du Pont's *Organic Chemicals Department*, for example, most technical men start in plant development groups, where they gain a background in both the technical and economic aspects of manufacture. Those with interests and abilities in production may then transfer to that field to acquire further, and more detailed, experience. Advancement leads to jobs as Building Supervisor, Senior and Chief Supervisors, and Superintendent.

The responsibilities of these supervisory levels vary, depending upon the men, the operation, and the products.

For example, in manufacturing dyes, up to 50 different operations may be carried out. Production and maintenance must be carefully planned and scheduled so that all needs for finished product are met. Temperature, pressure, and quality of reactants must be carefully controlled to insure that each batch of dye will match previous batches exactly.

In making each color, from 6 to 10 different unit processes may be called upon. And, in the course of time, all the unit operations known to chemical engineering come into play. Obviously, production supervisors have excellent opportunities to use and expand their technical knowledge and ingenuity. Equally important, they can acquire background and varied experience that prepare them for advancement to responsible positions in management and administration.

COLLEGE NEWS

Cornell Computing Center

A Cornell Computing Center organized around a Card-Programmed Electronic Calculator, will open at the university in September this year.

The CPC, a medium speed, digital, general purpose computer made chines, can process 150 cards a minute and perform 9,000 operations an hour.

The Computing Center will have three functions: to teach Cornell students how to use computers, to work problems for the faculty and students, and to serve industries and colleges of the area.

Students in the mathematics department's course in numerical analysis and those from other fields will get training in programming the machine's work, coding problems for it and operating it.

The Corning Glass Works and the General Electric Advanced Electronics Center here will use the facilities. The unit will also handle overflow work from the Cornell Aeronautical Laboratory in Buffalo, which has two computers of its own.

CPC gets instructions from codes punched on standard IBM cards. A reproducer, key punch, verifier, sorter and collator are auxiliary equipment.

The machine can do arithmetical problems, including square roots, logarithms and trigonometric functions. It can solve numerical integration and differentiation, matrix multiplication and inversion, and simultaneous equations, evaluate long formulas and compute special functions.

It can also handle accounting procedures, and may later be used to train students in the School of Business and Public Administration. The university's Machine Records Division, however, will still process work from the administrative offices.

Director of the center's staff of three full-time persons is Richard C. Lesser, who has been assistant director of statistical services at Massachusetts Institute of Technology for the past three years. He holds degrees in mathematics from Williams College and M.I.T.

The Cornell mathematics department will administer the center, with an advisory committee of faculty members from engineering, physics, sociology, statistics and other fields.

Engineering College Gets Die-Casting Machine

A die casting machine of the type which turns out large quantities of castings for automobiles, aircraft, household appliances and office equipment has been presented to the College of Engineering at Cornell University.

The donor is National Lead Company's Doehler-Jarvis Division. Cornell University is the fifth institution to receive such a machine under National Lead Company's Doehler-Jarvis Division University program.

The machines are utilized in college engineering and metallurgical departments to illustrate technical know-how for the classroom. In addition to the die casting machines, Doehler-Jarvis furnishes materials necessary for their operation and arranges periodic visits from Doehler-Jarvis engineers and scientists.

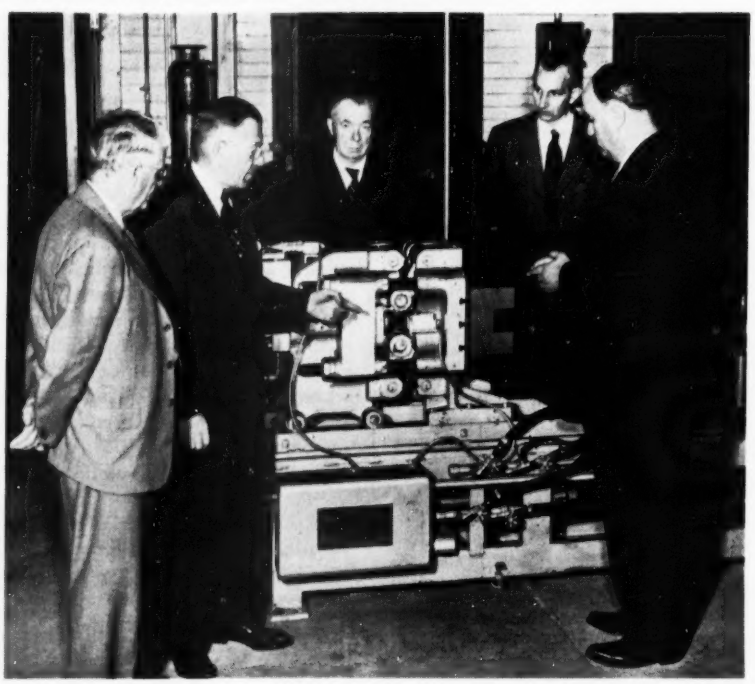
At Cornell the machine has been installed in the Foundry for use by the School of Chemical and Metallurgical Engineering. The work is supervised by Prof. Peter E. Kyle.

High Voltage Lab Erected

A massive windowless laboratory building will go into service here soon as new headquarters for Cornell University's studies of high-voltage phenomena.

The High-Voltage Laboratory, replacing one destroyed in a million-dollar fire in February, 1948, is ex-

A die casting machine, presented to Cornell by National Lead Company's Doehler-Jarvis Division is inspected in the University Foundry by (from left) Dr. Richard Parmenter, Cornell coordinator of research; Frank J. Koegler, general manager of the Doehler-Jarvis Division; Dr. F. H. Rhodes, director of the School of Chemical and Metallurgical Engineering; Dr. J. Eldred Hedrick, assistant dean of engineering, and Joseph A. Martino, president of National Lead.



pected to be in full operation in about a year. Like its predecessor, the structure will be used for teaching, research and testing in the high-voltage field.

Incorporating a number of innovations, and designed for easy expansion, the laboratory will rank with the finest facilities of its type.

A cavernous testing bay, soon to crackle with man-made lightning, will occupy most of the more than half-million cubic foot of space in the building. Railroad cars will run onto the testing floor to unload transformers, insulators and other heavy test equipment. Transmission towers will permit high-voltage line experiments.

Transformers and testing devices will be mobile to permit maximum use of the work-space. Apparatus can be erected outside also and test equipment rolled to it.

Once in operation, the center will be capable of testing to destruction almost any electrical insulator, according to Prof. Stanley W. Zimmerman, in charge of the activity.

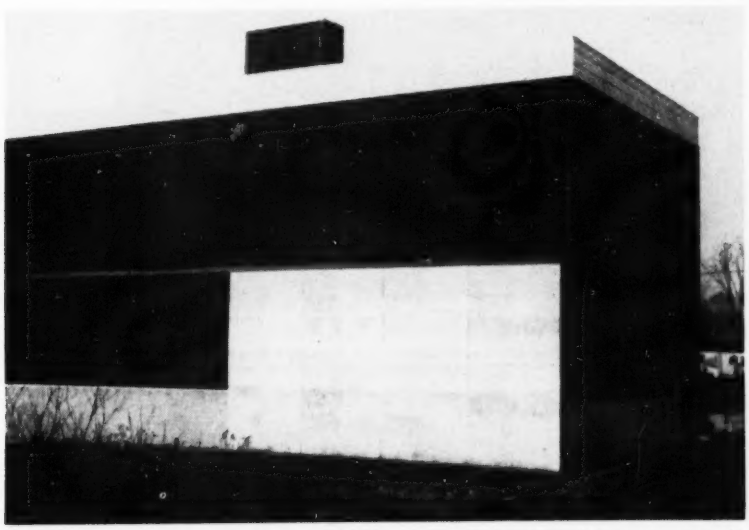
Fifteen-ton transformers will be able to produce 1,000,000 volts, single phase, or 600,000 three phase. Capacitor networks will permit electrical surges as high as 3,000,000 volts, with currents exceeding 25,000 amperes.

The Cornell engineers will be able to simulate a wide variety of conditions and to produce "standard lightning" strokes. Both man-made and natural lightning will be subjected to measurement. Lightning masts will pick up the atmospheric disturbances.

The laboratory will be used as well for the investigation of undesirable "corona" — the quirk which causes air to decompose, setting up electrical disturbances in nearby equipment.

Professor Zimmerman hopes the work will lead to new information about corona, the behavior and aging of insulating materials, and means and methods of applying stress control, thus contributing to more reliable electrical apparatus.

The center has had substantial encouragement from the electrical industry, which will use it for help with a range of problems.



The new structure housing the Cornell high voltage lab at East Ithaca. A railroad spur enters the building through the high doors.

IRE Hears Talk on Ware Focusing

Dr. Winston E. Koch, director of acoustics research at the Bell Telephone Laboratories, addressed a public meeting of the Ithaca Section of the Institute of Radio Engineers at 7:30 p.m. Friday (October 30) in the main lecture room of Franklin Hall at Cornell. His topic was "Focusing Sound Waves with Microwave Lenses."

The Cornell student section and I.R.E. sections from Binghamton, Syracuse and Elmira-Horseheads-Corning-Bath preceeded the meeting.

Dr. Koch's talk included a demonstration of simultaneous focusing of sound waves and microwaves by the same lens. Slides of the Bell Telephone Company's cross country microwave towers were also shown.

French Educators Study Cornell Teaching Methods

A team of 13 engineering educators from France, who are observing technical training methods in this country, visited the College of Engineering at Cornell on November 2 and 3.

The group's leader, Robert Y. Maxe, is general inspector of technical education in the French Ministry of Education. The other men are from the ministry, and are connected with technical and engineering education.

Their six-week tour is one of four being sponsored by the U.S. Foreign Operations Administration. M. H. Prang of the FOA is project manager and is traveling with the team.

Cornell is the first university they have visited and was selected as an example of advanced technical education in this country.

Welding Prize to Cornellian

Otto Eberlein, a fifth-year student in the School of Chemical and Metallurgical Engineering at Cornell University, has been awarded $150 in a national contest sponsored by the James F. Lincoln Arc Welding Foundation.

Under its 1952-53 Engineering Undergraduate Award and Scholarship Program, the foundation gave 46 cash awards as well as certificates and copies of a book, "Design for Welding." Eberlein was cited for a paper on "Design of a Welded Main Bearing Support."

The contest aims "to encourage engineering students to study how machines and structures made of steel can be improved and reduced in cost by the application of arc welding in their design."

For a successful engineering career, thorough background in welded steel construction is vital since:

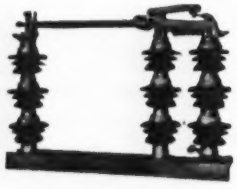
GOOD ENGINEERING DESIGNS DEPEND ON COST

With more and more emphasis being placed on cost of manufacture to meet competition, industry's management today looks to its engineers to initiate money-saving ideas in product designs. As a result, the alert engineering student who can come up with unique money-saving suggestions in his designs will find greater acceptance for his suggestions and a promising future in personal advancement and income.

Often too little attention is devoted to how a product design can be simplified to eliminate costly manufacturing manhours once a basic design is established. To achieve this end, where designers reappraise product details for welded steel construction, production costs are being cut an average of 50% compared with manufacture using castings.

The reasons for the lower cost with welded design are basic . . . lower cost of steel per pound, fewer pounds of steel needed and simpler shop procedures. In addition, steel designs are stronger . . . resist fracture from shock . . . are more modern in appearance.

FORMER BOLTED DESIGN *of base for electric switch. Bases range from 6 to 10 feet long. Are subject to severe cantilever stresses from opening and closing of switch.*



PRESENT WELDED STEEL DESIGN *incorporates tubular cross members. Weight cut 20%. Deflects one fourth as much under load. Costs no more to build.*

DESIGN DATA *for welded steel construction is available to engineering students in the form of Bulletins and Handbooks. Write . . .*

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

● LEROY* Lettering equipment is standard in drafting rooms everywhere. No special skill is needed for perfect, regular lettering and symbol drawing. There are LEROY templates in a variety of alphabets and sizes, as well as for electrical, welding, map, geological, mathematical and other symbols that the draftsman needs. *Trade Mark®

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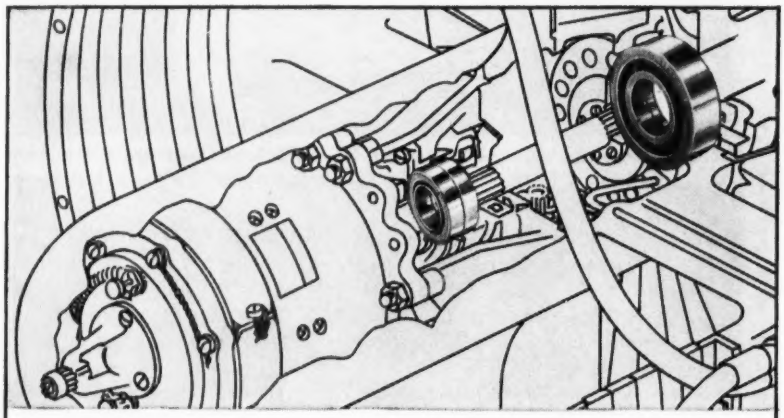
Drafting, Reproduction and Surveying Equipment and Materials, Slide Rules, Measuring Tapes.



Turning Points in Jet Engine Design

Designing more power into less space . . . a trend in jet engine development . . . puts a premium on space-weight saving factors as well as performance. That's one reason why jet engine designers are specifying more and more Fafnir Ball Bearings for every important turning point from main rotor to accessories and gear boxes. Fafnir Ball Bearings save space and weight as well as meet performance requirements established for the latest type jet engines. By keeping in step with aircraft progress, Fafnir continues to lead in the production of aircraft bearings. The Fafnir Bearing Company, New Britain, Conn.

AVAILABLE
A sound-motion picture depicting high points in the manufacture and use of Fafnir Ball Bearings is available to engineering classes. Write to The Fafnir Bearing Company, New Britain, Conn., for details.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

THE HYDROSTATIC TEST

Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

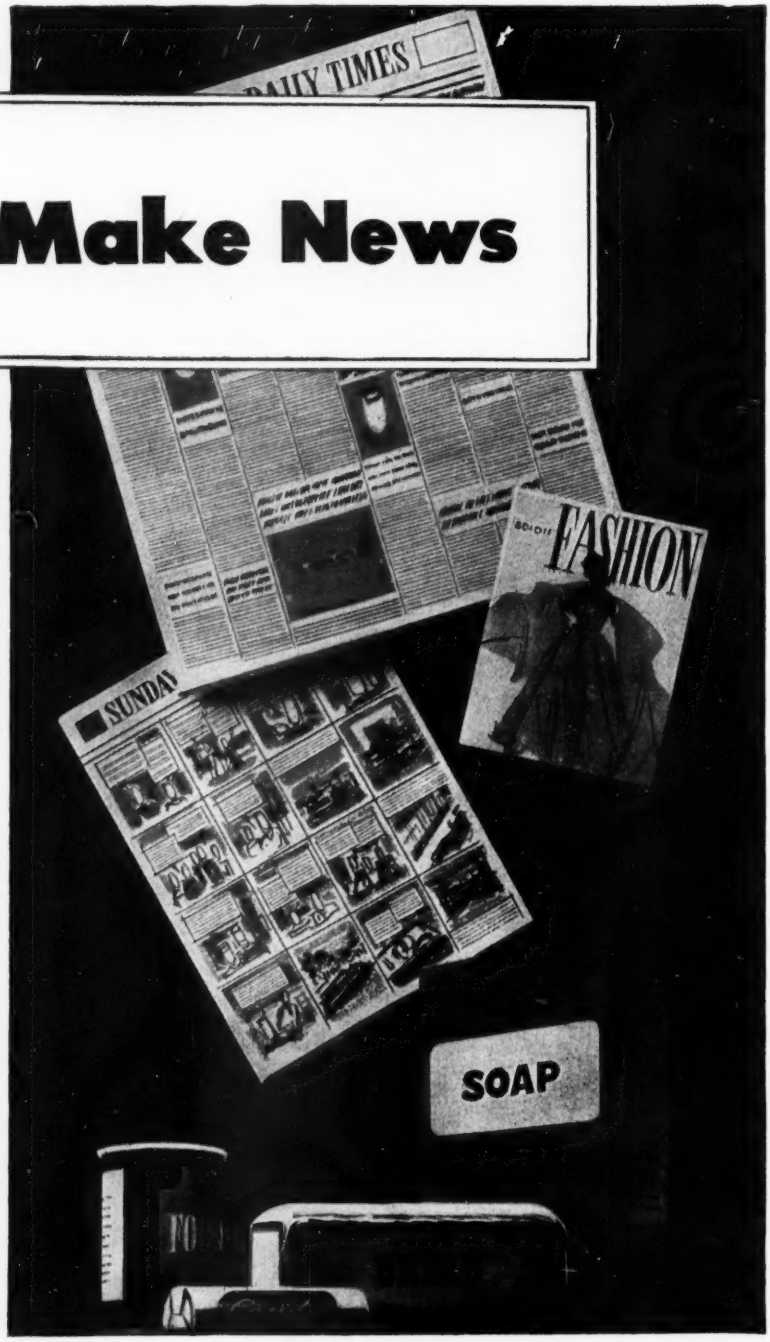
Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.

Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES

Resins Make News



CHEMICAL PROBLEM . . .

. . . inks that dry fast on today's high-speed presses; print clear on many different surfaces, such as magazine covers and packages.

SOLUTION . . .

. . . quality-controlled resins, developed by Hercules' rosin research, that are tailor-made for many modern printing inks. The Pentalyn® series, for example, and Limed Poly-pale® Resin, are found in rotogravure, letterpress, and lithographic inks. Other Hercules resins are used in flexographic (aniline) inks. Hercules also makes film-formers, such as nitrocellulose, ethyl cellulose, and Parlon®, for inks used on publications, bread and soap wraps, and for printing on foil, cellophane, and other hard-to-print surfaces.

COLLEGE MEN . . .

This is but one example of the far-reaching chemical developments in which you could participate at Hercules—in research, production, sales, or staff operations. It suggests the ways Hercules' products serve an ever-broadening range of industries and end-uses.

Hercules' business is solving problems by chemistry for industry . . .

. . . soaps, detergents, rubber, plastics, paint, varnish, lacquer, textiles, paper, insecticides, adhesives, to name a few, use Hercules® synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products and other chemical processing materials. Hercules® explosives serve mining, quarrying, construction, seismograph projects everywhere.

HERCULES

HERCULES POWDER COMPANY Wilmington 99, Delaware
Sales Offices in Principal Cities

TECHNIBRIEFS

Outsize X-Ray

A 40 by 120-inch radiograph, the largest yet produced on a single piece of film, was displayed October 19 through 23 at the Nation Metal Congress & Exposition in Cleveland by Allis-Chalmers Manufacturing Company.

The giant magnification of two Winchester rifles—an old buffalo weapon and a modern piece—was accomplished with an 22 mev betatron by using a "magna scanning" technique.

Magnification of the rifles was accomplished by direct geometrical enlargement with the film placed eight feet from the specimen. The target to specimen distance was four feet and the target to film distance 12 feet. This resulted in a magnification factor of three. The scanning arc traversed was about

—Allis-Chalmers

Safe lights illuminate laying of unwieldy film. Since no film holder of the size needed was available, the standard Eastman Kodak Type A film was laid directly on a fiber board platform and covered with 16-gauge steel sheet.

40 degrees which resulted in the center of the X-ray beam being swept across the full length of the specimen.

This technique when employed in industrial radiography has been successful in revealing details of flaws down to .001 inch. A fine focal point and minimum secondary scattering are absolute necessities in this operation.

The scanning technique used in producing this radiograph is similar to the old panorma pictures in that the betatron is rotated during the exposure just as the camera was rotated while the lens was open. In this operation the focal spot must remain effectively fixed in space while the betatron rotates with only the direction of the emitted X-ray beam changing.

Industrially this method is best applied to repetitive jobs which justify technique development.

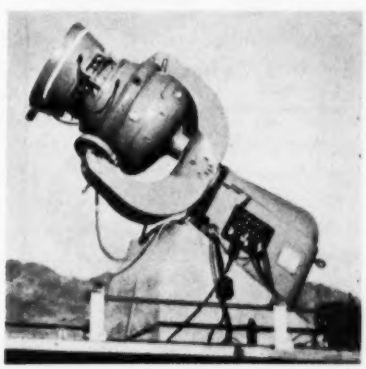
Ceramic Coated Nickel

One of the first successful methods for applying a ceramic coating to commercial nickel has been announced by Oak Ridge National Laboratory, Oak Ridge, Tennessee, operated by Union Carbide for the Atomic Energy Commission. The process is regarded as being of considerable importance, since nickel, which is one of the refractory metals, possessing excellent thermal conductivity characteristics, is limited in its use at high temperatures because of its poor resistance to oxidation. The new coating process may permit the use of nickel in jet engines, gas turbines, guided missiles, and other high-temperature devices.

The coating method consists of annealing nickel specimens in water-saturated hydrogen at a temperature of 1000 degrees Fahrenheit. The specimens are then sprayed with National Bureau of Standards ceramic coating A-418, dried, and fired. The durability of the coating has been tested by heating the specimens in an oxidizing atmosphere at 1500 degrees Fahrenheit for 65 hours. At the end of the test the specimens still had a good appearance and showed improved adherence of the coating.

Meteor Camera

A new type of telescope-camera is now being used by Harvard astronomers on a Navy project to learn more about the earth's upper atmosphere. Because meteors perform like bullets and other projectiles, the studies are expected to prove useful to the armed forces in high-altitude rocket experiments.



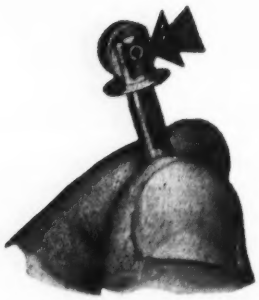
—Eastman Kodak

Schmidt-type camera designed for use in meteor research. This camera is operated by Harvard University

Two of the huge, 5000-pound meteor cameras are now located at Harvard's meteor stations near Las Cruces, New Mexico. Now being operated under contract with the Office of Naval Research, they serve as the main instruments in Harvard's photographic meteor program which has been in progress since 1936.

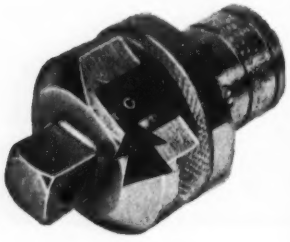
Possibly the best demonstration of the usefulness of these cameras for photography of meteors is the performance of the first camera while it was operating on the same sky region with one of the earlier "meteor" cameras. During this period the Super-Schmidt photographed 56 meteors. Only one of these was caught by the older camera.

Meteors, mostly fragment broken off minor planets or comets, and



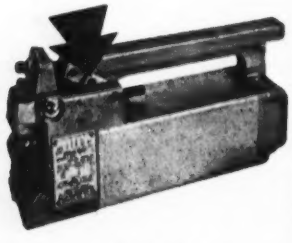
Replacing a rivet

. . . a hinge pin



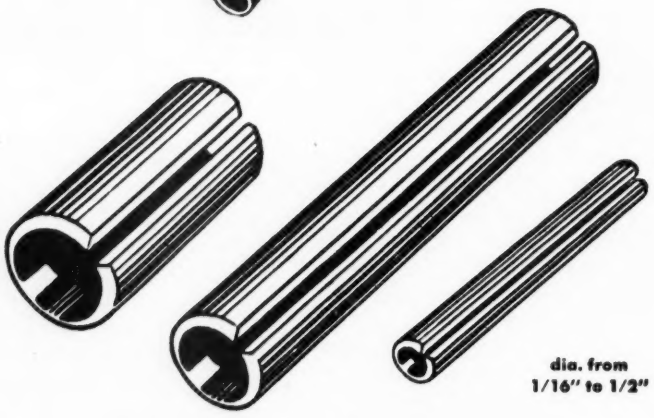
. . . a stop pin

. . . a set screw



. . . a bolt and nut

ROLLPIN



dia. from 1/16" to 1/2"

. . . a modern fastener that saves time and money on thousands of applications

Rollpin is a hollow, split, cylindrically formed pin with chamfered ends. It is simply driven into holes drilled to normal production tolerances. Because Rollpin is slightly larger than standard sized holes, it compresses as inserted. It is self-locking—and vibration-proof—because of the constant pressure it exerts against hole walls. Its shear strength exceeds that of a cold rolled pin of the same diameter. Rollpin is readily removed with a drift or pin punch—and can be reused.

Because of its versatility—and the production economies it makes possible—Rollpin is finding wide usage in almost every phase of manufacturing activity. Write for design information on the Rollpin. It will enable you to cut costs for many applications where use of rivets, set screws, dowels, and straight, serrated or cotter type pins create installation or performance problems.

ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, New Jersey

Elastic Stop Nuts with the famous red collar are another ESNA product

ESNA

sometimes no larger than buckshot, are being photographed by the Harvard scientists as a part of their sky survey. The cameras are extremely fast (f/0.67), with a wide enough field to cover an area 10,000 times the size of the moon at one time.

Magnetic Memory Device For Electronic Computers

Successful experimental operation of a very high-speed electronic memory device that promises to help solve scientific and economic problems too vast and too complex for the present capabilities of electronic computers has been revealed by the RCA Laboratories Division.

The new memory device, which combines the feature of high speed with a potentially huge information storage capacity, was described at a recent symposium on digital computers.

The memory section is often considered the weakest link in present-day computers. Various memory systems now in use are either fast in receiving and giving out information or they can store vast quantities of information, but none has been able to do both. Besides, many systems are not completely reliable, i.e., they tend to "forget" or "scramble" some of the information they have stored before it is wanted by the parts of the computer that do the actual computing.

The new device appears to offer significant advantages for computers of the future because:

1. It can "memorize" or "recall" a bit of information in a few millionths of a second. (A bit of information is expressed as "0" or "1" in a computer. In combination with other bits, it can represent numbers or words or symbols).

2. It can store 10,000 bits at any one instant. With 100 such devices connected together, which is theoretically possible, a million bits could be stored. A million bits is more than would be needed to translate five solid pages of a newspaper into the memory's language.

3. It potentially has a very high degree of reliability, since its tiny magnetic cores never wear out no matter how much information is fed in or out. Besides, a core could hold the same bit of information for years, if this were desired.

4. It promises to be relatively cheap, as memories for computers go.

The heart of the present 10,000-core memory is a grid—or matrix—of a hundred closely spaced wires at right angles to which run a hundred more wires.

At each intersection of the wires is a magnetic core. Through the center of each core runs one vertical wire and one horizontal wire.

Such is the lot of the coed who follows a bunch of jazzy fraternity men across the suspension bridge.

The cores, which are about the size and shape of the typewritten letter "o" and one-fifteenth of an inch thick, are made of a special ferromagnetic spinel, a ceramic-like material.

The magnetic material of the cores is such that when there is an electric current of a certain intensity flowing through the two intersecting wires a core will switch its magnetic polarity from positive to negative, or negative to positive, depending upon the direction of the current.

Current of the same intensity in one wire alone is not enough to trip the polarity. Thus only when currents are flowing in both wires, will the core at their intersection flip into opposite polarity (if it is not in that state already) causing the core to "memorize" one bit of information.

Thus by apply a current to a particular horizontal wire and a particular vertical wire only the core at their intersection may be tripped.

Recalling, or reading out, information from the memory is also accomplished by operating on one core at a time. The operation is so fast that a hundred thousand bits can be withdrawn in a second.

The core to be interrogated is subjected to pulses along its two intersecting wires. If the core is tripped into opposite polarity, its reversal of polarity creates an electrical signal in a wire that runs through the center of all 10,000 cores. If it is not tripped, no signal appears in the common wire. In either case, the nature of the bit of information it contains is determined. (If the core is tripped in reading out, it is automatically returned to its original state by associated circuits, thus no permanent erasure of information need take place.)

The basic principles behind the new device, which is formally called the "Myriabit Magnetic Core Matrix Memory," were incorporated in an earlier experimental memory completed last year which had sixteen horizontal and vertical wires, thus a storage capacity of 256 bits.

DuPont to Produce New Photo Film Base

A commercial unit for the manufacture of a new synthetic base for photographic film will be built by Du Pont.

A condensation polymer, technically known as polyethylene terephthalate, the new base is chemicalley related to "Dacron" polyester fiber.

Outstanding characteristics of the film base, its great strength and high dimensional stability, make it particularly well suited for motion picture film and for such industrial photographic uses as lithographic film, microfilm, and film for aerial mapping.

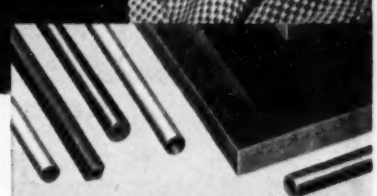
You can't see SYNTHANE but it's in the picture

There are important factors about picture-making you never see in the print—the photographer, the lights, the darkroom, the chemicals. One of many materials essential to photography is Synthane—a laminated plastic.

Synthane is corrosion-resistant . . . Synthane spools carry film from early stages of emulsion coating through developing. Synthane is opaque to infrared rays which accounts for its use as slides for film packs. Synthane is an electrical insulator; you'll find it hidden in flash guns, lighting equipment and projectors. Synthane is wear-resistant and vibration-absorbing, fine for quiet gears in movie cameras.

The photographic industry is only one part of the American industrial picture, and the properties for which Synthane is valued in it are only a few of the many Synthane has. Others are good tensile, compressive, flexural, and impact strengths, dimensional stability, light weight, high dielectric strength, ease of machining. Synthane has all these properties—and more—in combination. And the combination may be valuable to you.

To get the complete picture of Synthane and its possible place in your product, write today for the 24-page Synthane Catalog. Synthane Corporation, 42 River Road, Oaks, Penna.



Here you see the three basic forms of Synthane laminated plastics—sheets, tubes and rods. All three are made by applying heat and high pressure to resin-coated laminations of paper, fabric, glass cloth or mat. Synthane is thermo-setting, has many much-sought properties in combination.

Synthane in Photography

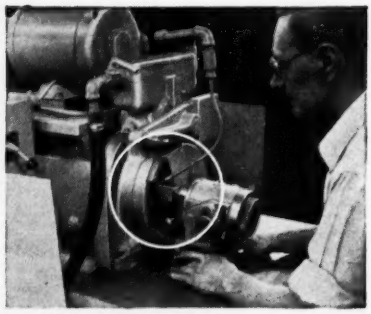
A—16mm Reel
B,C,D—Film processing spools
E,F—Chemical-resistant screws for developing equipment
G—35mm film carrier

Synthane-one of industry's unseen essentials

SYNTHANE

LAMINATED PLASTICS

Newest Addition to Norton Company's vast facilities for supplying abrasives and abrasive products is this seven acre expansion for building fine grinding machines on an "in-line" production basis.



A "Touch of Gold." This man is test running a new BURA-WAY Tool Grinder equipped with a Norton G Bond wheel. G Bond is a revolutionary 1953 Norton vitrified bond development for faster and cooler cutting.

The

"TOUCH OF GOLD"

in grinding operations starts with Norton products

Wherever products are ground or finished, industry *can* have the modern "Touch of Gold."

This means using the Norton grinding wheel exactly engineered to the particular job. Then with each grinding operation, value is added to the product . . . the profit margin is increased . . . and the ultimate user gets better quality.

Here at Norton is more than a mile of the world's largest, most modern abrasive manufacturing plant . . . for providing operators with the "Touch of Gold." This big, bustling community ships out more abrasives and abrasive products to all parts of the globe than any other single source. Here, also, is situated the world's newest and finest grinding machine plant ever built.

Norton Abrasive Research ...A Career

At Norton more than 100 trained scientists and technicians in 19 specialized fields are constantly exploring every phase of product improvement and application. A career at Norton would mean "growing with the future" for you. Wherever you carry on your life work remember Norton as the place where the job is "Making better products . . . to make other products better." Address NORTON COMPANY, Worcester 6, Mass.

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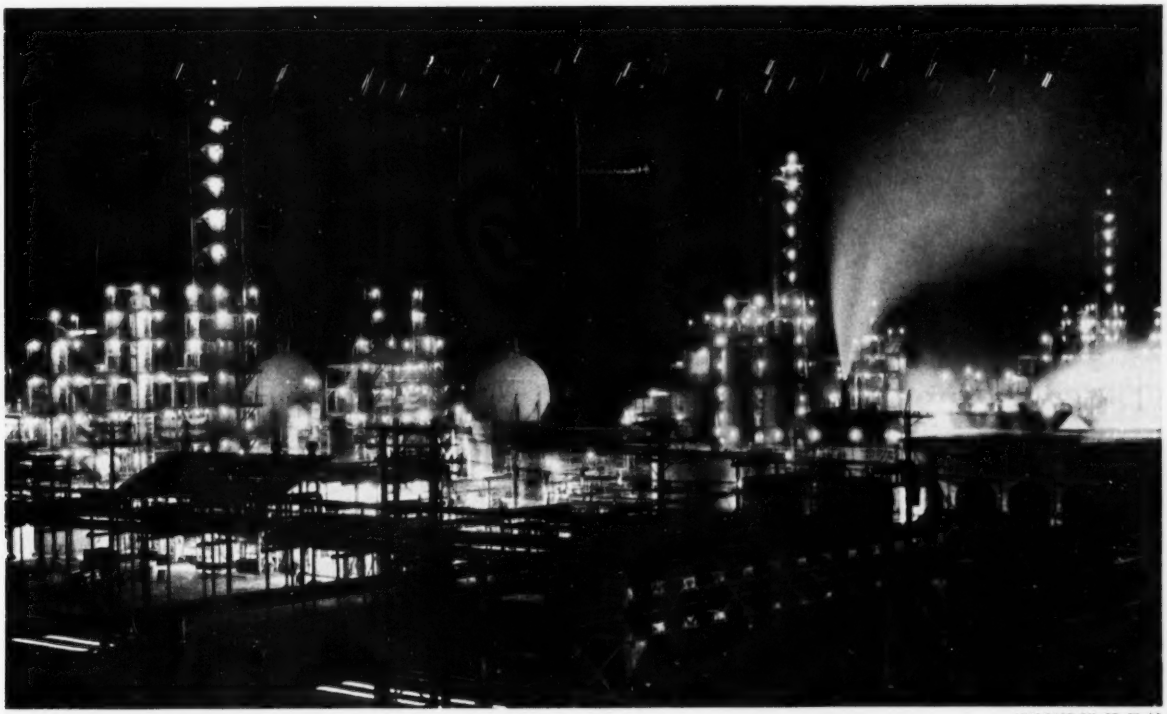

STANDARD OIL CO. (N. J.)

OIL REFINING 'ROUND THE CLOCK is only one of many chemical process industries which consume vast quantities of catalyst carriers or supports to promote efficient chemical reaction. CARBORUNDUM® makes catalyst supports of the "man-made minerals" available in 17 different compositions and three different degrees of porosity, the better to meet the varied needs of a wide range of processes. The right combination of composition and porosity assures maximum dispersion of the catalyst, while high chemical stability and great mechanical strength assure long support life. In both fixed-bed and fluid-bed applications, CARBORUNDUM catalyst supports are widely used throughout the industry.

Produced by the Refractories Division

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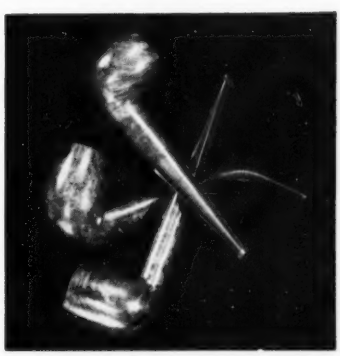
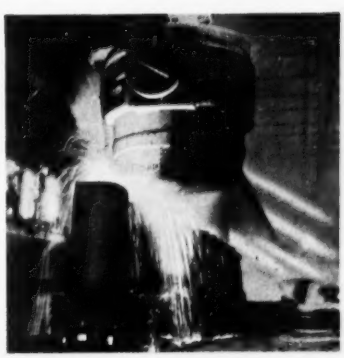


THE BEAUTY OF A BRIAR PIPE is no accident. Bowls, tops, shanks—even the plastic or hard rubber mouthpieces—are roughed and finished with abrasive paper. Leading pipe manufacturers buy CARBORUNDUM silicon carbide abrasive paper in rolls from which they cut special shapes and sizes for use on flat or "French" wheels.

Made by the Coated Products Division

PURER STEEL is the constant goal of leading steel company metallurgists, who are striving to increase the quality of steel without adding substantially to cost. They are powerfully aided by FERROCARBO,® a special formulation of one of CARBORUNDUM's "man-made minerals," which does a remarkable job of purifying molten steel by carrying off metallic oxide impurities into the slag.

Manufactured by the Bonded Products and Grain Division



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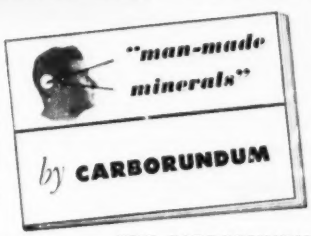
describing how imaginative thinking—yours and ours—can put "man-made minerals" to work for you. Write for it on your business letterhead. No obligation, of course.



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for help on your problems that "man-made minerals" may solve

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Aviation

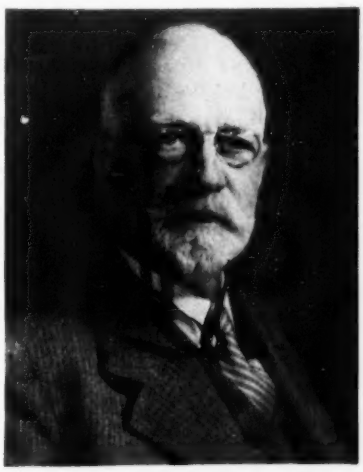
(*Continued from page 20*)

master's degree in Mechanical Engineering in the early 1900's, he collaborated with Professor C. B. Upton to build the Upton-Lewis fatigue-testing machine.

The recipient of several honorary degrees and of numerous awards, Lewis was selected in 1929 by the American Society of Mechanical Engineers as one of the ten men most responsible for advances made in aeronautical science. He represented this country at an Inter-American Aviation Conference before the last war and contributed to aviation development during the war. He was retained by NACA as a research consultant until his death in 1948.

William F. Durand

Considered the dean of aerodynamicists, William F. Durand became associated with Cornell University in 1891, when he became a professor in marine engineering. After serving as director of Sibley College for two years, he went to Stanford in the early 1900's and remained there to become an emeritus professor in 1924. Durand did research in the fields of hydrodynamics, thermodynamics, and aerodynamics and studied the propulsion of ships and the performance of ship and air propellers.



A long-time member of the National Advisory Committee for Aeronautics, Professor Durand served as its chairman immediately before the First World War. He was also a member of the National Research Council. His greatest contribution to the science of aerodynamics was his editing of a comprehensive six-volume work "Aerodynamic Theory," which summarized all knowledge of the science in 1934; considered the "Bible" of aerodynamics, it is still in use today.

Dr. Durand served the government in various capacities, chief among which were the chairmanship of a committee to investigate dirigible problems in the 1930's and the heading of a 1940 committee to investigate possibilities of jet propulsion. He acted as a consultant on dams for the U.S. Bureau of Reclamation from 1930 to 1943.

Durand's accomplishments won him wide recognition with the award of the Guggenheim medal and other prizes. In honor of his many contributions the Institute of Aeronautical Science has recently dedicated to him their museum in Los Angeles—the "W. F. Durand Aeronautical Museum."

STRESS and STRAIN...

A small boy's head bobbed up over the garden wall and a meek little voice said, "Please, Miss Holcomb, may I have my arrow?"

"Certainly, young man, where is it?"

"I think it's stuck in your cat."

* * *

"What's the hurry?"

"Just bought a textbook and I'm trying to get to class before the next edition comes out."

* * *

The reason for the amber light on the traffic signal has finally been revealed: It gives the Scotchmen a chance to start their engines.

* * *

A professor, whose theories were always open to doubt, but who nonetheless found many and devious ways of proving them, was lecturing on insects at a university.

"On my right hand," he said to his students, "I have a flea. I now order him to jump over to my left hand. As you see, the flea obeys me. Now," he continued, "I remove the legs of the flea and order it to jump. You note that it does not jump. Therefore, we have scientific proof that a flea whose legs are removed becomes deaf."

* * *

Two men, neither very bright, were helping to build a house. One kept picking up nails, looking at them, keeping some and throwing others away.

"Why are you throwing away so many nails?" asked his companion.

"Because they are pointed the wrong way. They have the head on the wrong end."

"You fool. Those are for the other side of the house."

* * *

Bus driver: "All right back there?"

Feminine Voice: "No, wait till I get my clothes on."

Then the driver led a stampede to the rear and watched the girl get on with a basket of laundry.

Discipline Advisor: Jones, you disappoint me. I've been told that you were seen at the class party intoxicated and pushing a wheelbarrow around the room."

Jones: Why, yes, I thought you approved.

D.A.: Of course not! Why should I?

Jones: You were riding in the wheelbarrow.

* * *

He didn't say a word when they ran over his cat with a steam roller; just stood there with a long puss.

* * *

An engineer caught his girl in a brother engineer's arms. To their startled expression he calmly replied: "I don't mind if you neck with my girl, but there is going to be one peach of a fight if you don't take your hand off my fraternity pin."

* * *

Grandmother looking at her granddaughter's new abbreviated dress: "If I could have had dresses like that when I was a girl, you'd be six years older today."

* * *

Famous last words: "Hell, he won't ask us that."

My slide rule is my shepherd, I shall not want.

He maketh me to set down to the third place; and leadeth me to interpolate to the fourth.

He restoreth my average; and leadeth me along the paths of correct answers for his name's sake.

Yea, though I walk through the valley of the shadow of pop quizzes, I will fear no professor; for my slide rule is with me.

His log scales and trig scales they comfort me.

Thou preparest an answer for me in the presence of my professors, thou anointest my paper with right answers and my brain relaxes—

Surely Quality and Accuracy shall follow me all the days of my life and I shall dwell in the house of K & E forever.

* * *

Last night I held a little hand,
So dainty and so sweet.
I thought my heart would surely break,
So wildly did it beat.
No other hand in all this world,
Can greater solace bring,
Than that sweet hand I held last night.
Four aces and a king.

PHOTOGRAPHY AT WORK No. 4 in a Kodak series

Photography helps a New Steel Mill roll into action

Fairless Works, U. S. Steel's new Eastern Seaboard mill, is now starting operations—and growing—at the same time. And camera and film play their parts in both.

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From ore through research and production, Photography is one of Steel's important operation tools. It helped locate and appraise the new Venezuelan Cerro Bolivar deposits which sparked this great new seaboard mill. It helped chart the ore's course to the sea—helped plan the plant and keeps a running record of its growth. And day after day it's at work in the research lab improving steel metallurgy, and on the production line controlling quality.

Countless numbers of America's varied industries, large and small, use photography in many ways to save time, speed accomplishment, increase production, and cut costs.

In fact, so many new applications of photography are being found, that many well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. Returning servicemen, too, have found new opportunity here.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

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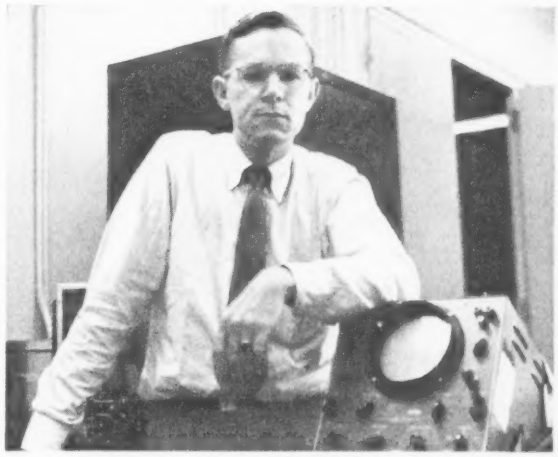
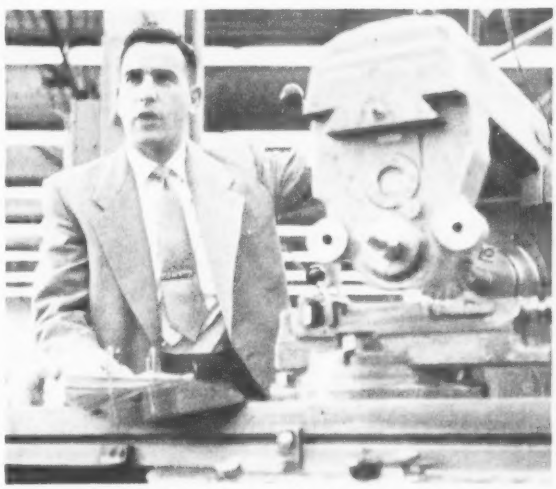
"On the basis of the experience thus acquired, I have been able to make an intelligent choice of the particular field of engineering for which my talents, interests, and abilities are best suited."



GERALD R. PETERSON, U. of Calif., BS, electrical engineering.

"I joined General Electric because of the many opportunities I found available for building a successful career. In my chosen field, manufacturing, a development program gives each individual the opportunity to advance his own abilities and talents under experienced guidance. Work assignments, classroom instruction, and discussion periods give every opportunity for career development. Also, an opportunity for specialization is offered through working assignments in all major divisions of manufacturing.

"Through assignments in these areas a logical decision can be made on final job placement. To me this seems extremely valuable in putting the right man and the right job together, and thereby greatly enhancing the possibility for success."



DAVID J. DILLON, U. of Ill., BS, management.

These are but two of the many reasons why hundreds of college graduates come with General Electric each year. These men are part of the large group of young people who are getting ahead *fast*—in an industry where there is broader scope for your ability . . . where your future is not chained . . . where you work in an atmosphere of vigorous, progressive thinking.

If you are interested in building a career with General Electric see your college placement director for the next visit of the G-E representative on your campus. Meanwhile, for further information on opportunities with G.E. write to College Editor, Dept. 2-123, General Electric Co., Schenectady 5, N. Y.

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